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THE Human Frame AND FIVE SENSES

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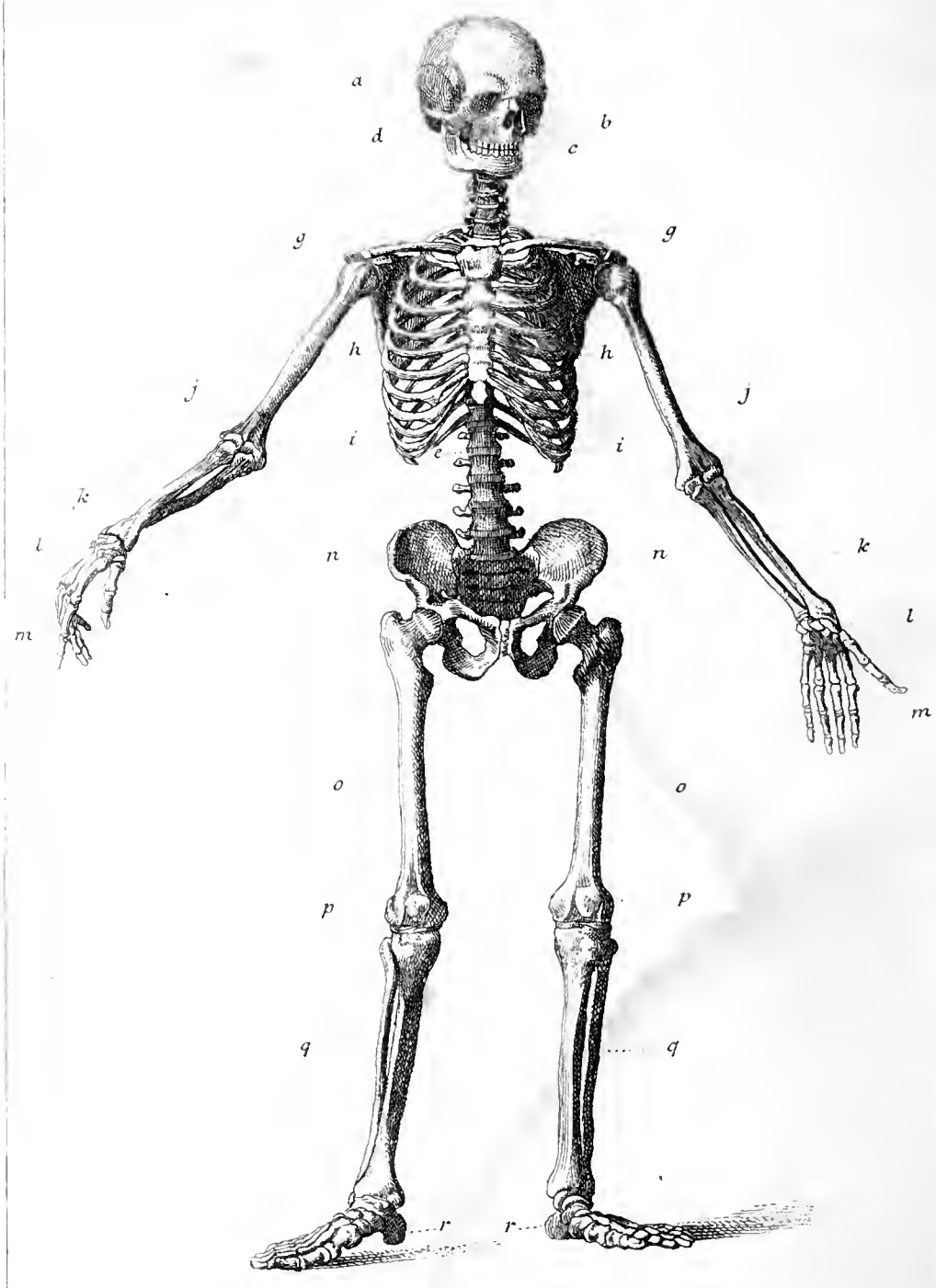
Plate I.A.



CONVERSATIONS

ON

THE HUMAN FRAME,

AND

THE FIVE SENSES.

BY THE
AUTHOR OF "AIDS TO DEVELOPEMENT," "A GIFT FOR MOTHERS,"
"MEMORIALS OF TWO SISTERS,"
ETC. ETC.

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PREFACE.

Some of the following Conversations have previously appeared in one of the periodicals of the day. Since that time they have undergone both addition and revision, and the series has been completed.

The subject of the volume is one not generally considered suitable for the young; but the idea of sketching this outline of Anatomy was suggested to the writer's mind, by the questions of some children, who were anxious to obtain information upon it, and no work could be found sufficiently simple to put into their hands.

In commencing a course of lessons on Natural History, the question presents itself, What is the right plan to be pursued? Is not the proper starting point the wonderful construction of our own frame, together with the curious instruments by which the mental powers are called into exercise; and should not this study always precede that of the habits and manners of other animals?

The first authorities have been consulted, and no labour spared, in order to make this little work as perfect as possible in all its details; but on a subject which requires the scientific knowledge of the other sex, the writer would not have presumed to consider her statements correct, had she not been assisted by a valued medical friend, to whom she submitted each paper which related to anatomical subjects.

To him the Author gratefully acknowledges her obligations, both for directing her to the most suitable works, from which to draw information, and

for the kindness with which, amidst numerous professional engagements, he sacrificed his time to revise her imperfect attempts.

CONTENTS.

ON THE HUMAN FRAME.

Conversation I.

Frank. I have often wished, mamma, that you would tell us how we are made; I cannot think how we can move, and turn about, in every different direction.

Jane. And how can we see, and feel, and hear?

Emily. And how can we think, mamma?

Mamma. You have put a great many hard questions to me, my dears, but I will try to answer them as far as I can; you will however find, after all the explanation I can give you, that we are so "fearfully and wonderfully made," that there is much which cannot be found out. We learn from Genesis ii. 7., that these curious bodies of ours were formed

"of the dust of the ground;" and we read in Gen. iii. 19., that God said to Adam, after he had sinned, that he should "return unto the ground," and he gave him this reason, "for out of it thou wast taken, for dust thou art, and unto dust thou shalt return."

EMILY. But if he was only made of dust, how could he move and speak? If I made a body out of dust it could not do anything.

MAMMA. True, but in the same verse in which Adam's creation is spoken of, it says, that "God breathed into his nostrils the breath of life, and man became a living soul." We do not know how this was; but we know that when the breath is gone out of any one, that is, when he dies, that the body gradually crumbles to dust again, and has no power left, either to move or speak. The same thing is told us in Eccl. xii. 7., "Then shall the dust return to the earth as it was, and the spirit shall return unto God who gave it."

FRANK. I wish we *could* comprehend how it all is; but, dear mamma, you know a great deal about how our bodies are made, will you explain to us as much as we can understand?

MAMMA. I will do so with pleasure. You know that under your flesh, there is something firm and solid, which supports it,—what is this called?

JANE. Bone.

MAMMA. Yes, we have a great many bones in our bodies; more than you would suppose.

FRANK. How many—a hundred?

MAMMA. About 260, including the teeth, which are each of them separate bones.

EMILY. Is that possible! I had no idea there were so many.

MAMMA. Yes; and each one of them is made to perform some particular purpose.

JANE. And are they loose, under our flesh?

MAMMA. No; most of them are united by joints, just as a door is joined to its frame by hinges. These joints are also differently made, according to the objects for which they are wanted.

EMILY. How do you mean, mamma?

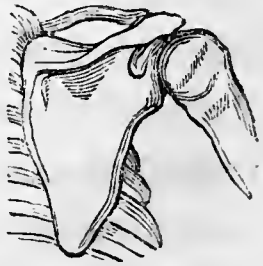
MAMMA. Do you want your knee to move round in every direction, in the same manner as your arm?

FRANK. No; we should walk very unsteadily if it did.

MAMMA. You would; so at the place where the bone of the thigh is joined to those of the leg, there is a hinge-joint; but as the arm would be of little use, unless we could turn it round, as well as move it up and down, it is united to the shoulder, by what is called a ball-and-socket-joint.

EMILY. What is that, mamma?

MAMMA. The bone of the shoulder has a hollow or socket, formed something like the cup, in which the acorn grows; so that the bone of the arm, which fits into it, can move either round, or backwards and forwards without difficulty.



Shoulder Joint.

JANE. But does it not slip out of its place very often?

MAMMA. This sometimes happens, if an unusual effort is made, or in consequence of a violent blow; but it is so strongly secured in its place, that these accidents but rarely occur.

JANE. I should think, mamma, that there are hinge joints in our fingers, because we move them

up and down, like the hinges of a box, and do not turn them round and round.

MAMMA. You are right, my dear.

EMILY. Is there more than one bone in each of our arms?

MAMMA. Yes; there are two between the elbow and the wrist, the joints of which are so contrived, that we are able to perform the movements both of bending our hands up and down, and of turning them partly round. A similar plan is adopted in the formation of the top of the back-bone, which is called the spine. The head is united to it, by a hinge joint, so that it can be moved backwards and forwards; but the second joint is of a different kind, to enable it to turn from side to side.

FRANK. Will you, mamma, begin at the head, and tell us about each of the bones, in the order in which they are placed in the body, because we are so covered with flesh, that we cannot find it out?

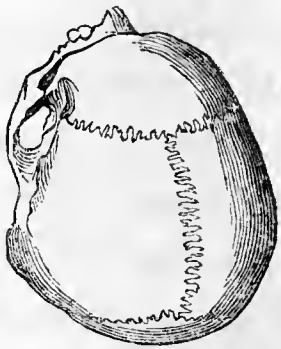
MAMMA. I will. The head is composed of many different bones, which are strongly fastened, and which fit very closely into each other.

JANE. Oh! I thought that our heads were made of one great piece of bone?

MAMMA. You see you were mistaken. In babies these pieces are very slightly joined together, and the bones are not hard, so that a trifling blow might do them great harm; but, as we grow older, the bones increase in strength and hardness.

EMILY. Are the separate pieces joined together by hinge joints; could they not be united in the other way you described to us?

MAMMA. No, in quite a different way to both: with regard to the nature of the joints, which form the skull, or cavity containing the brain. These joints are innumerable; and the bones are connected by what are called *sutures*. These are formed by projecting portions from the sides of each of the bones to be united, and which fit exactly the one into the other, so as to make an even surface. They are thus so closely compacted together, that unless some of the parts are



Top of the Skull.

Bones of the Head.

Fig. 1. Bones of the head entire.

a Frontal bone, or bone of the forehead.

b One of the parietal bones.

c One of the temporal bones, or bones of the temples.

d Occipital bone.

e Lower jaw.

Fig. 2. Frontal bone detached.

Fig. 3. One of the parietal bones detached.

Fig. 4. One of the temporal bones detached.

Fig. 5. Occipital bone detached, showing the opening through which the spinal chord is connected with the brain.

Fig. 2

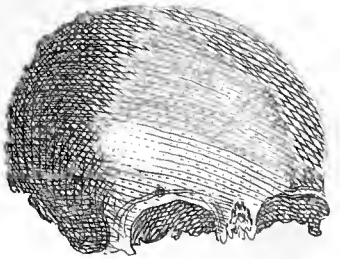


Fig. 3

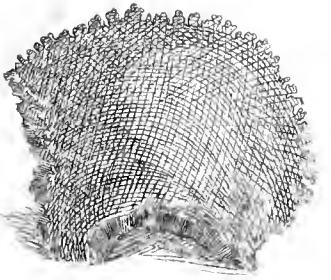


Fig. 1

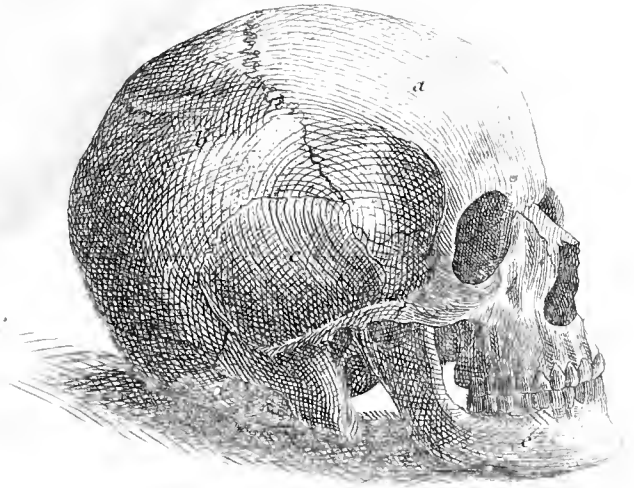


Fig. 4

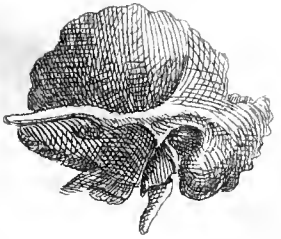


Fig. 5

The bones of the Head

broken off, they are absolutely inseparable. At an advanced period of life, the sutures are often imperceptible, and you cannot see where the bones are joined.

EMILY. We have sometimes cut the peel of an orange into fine teeth, so that one side exactly fitted into the other, and you could hardly see where it was divided. Is that something like the sutures, mamma?

MAMMA. Yes; that will help you to understand the nature of those in the skull, the teeth of which are very fine. This contrivance gives peculiar strength and firmness to the head, so that it is less liable to be hurt than any other part of the body. You see here the wisdom of God; because, as the skull contains the brain, any injury to which destroys either reason or life, we should have been in perpetual danger, had it not been so well protected.

EMILY. We should, indeed!

JANE. Then there is a great bone for the nose, is there not, mamma?

MAMMA. No; the part of the skull which forms the base of the nose, does not extend far.

EMILY. But surely our noses are made of bone?

MAMMA. No, indeed, they are not; they are only formed of strong cartilage, which you can easily bend from side to side.

FRANK. How curious!

EMILY. But I can feel hard bones at the sides of my face.

MAMMA. That which you feel under your eyes is part of the skull; it forms the base of the face, and is continued as far as the ear. If you press your fingers against each side of your nose, you will feel that the upper jaw is also part of the bone of the face, and is continued from the bony portion of the nose, leaving a hollow for the insertion of that feature.

FRANK. But, mamma, if the upper jaw was a part of the skull, how could we move it up and down?

MAMMA. You never move your upper jaw.

JANE. Not when I eat, mamma?

MAMMA. No; you may try.

JANE. Am I not moving it now? It seems to me that I am.

EMILY. No Jane, mamma is quite right; you are only moving your lower jaw up and down.

MAMMA. Just so; half of the teeth are fixed in the upper, and half in the lower jaw.

EMILY. Then how does the lower jaw move,—is that a separate bone?

MAMMA. Yes it is.

FRANK. Let me guess. Is it not united to the other by a hinge joint?

MAMMA. It is.

FRANK. Do, sisters, put your fingers just in the middle, where the ear joins the cheek, and open and shut your months, and then you will feel the hinge-joint quite clearly. Is it not a funny feeling?

JANE. It is indeed; it is just like a pair of nut-crackers. But we do not crack our food, do we?

MAMMA. No; the process of eating is more like grinding, and our tongues also help us in the work, as they move the food about from place to place, till it is properly chewed. The saliva also helps to soften and dissolve it.

FRANK. If I thought of all these things, every time I was eating, I should hardly be able to get on.

MAMMA. But we had better now keep to the bones, as I promised to explain that subject to you first. Do you think that you understand clearly, about the formation of the skull, that is to say, of the bones which together form the head?

CHILDREN. Yes, mamma.

MAMMA. The head, as I told you, is joined to a large, strong bone, which forms the back of the body. This, though it bears but one name, that is the spine, consists of twenty-four bones, called the vertebræ, which are fitted one into another.

FRANK. Why would not one strong bone have answered the purpose better, than so many separate pieces?

MAMMA. Suppose, Frank, I was to put a bar of iron upon your spine, and was to fasten you to it, and then tell you to stoop down and pick up something for me, do you think you should do it very gracefully?

FRANK. No; I should not be able to do it at all, no, nor to turn my body round, or to move, or to do

most of those things I can now do so easily. Oh, mamma! I see what you mean; how foolish it was to think, that one bone would have done as well as all those pieces you told us of.

MAMMA. Did you ever observe the back-bone of a fish, how all the parts were curiously fitted into each other?

EMILY. Oh, yes; they were something in the shape of reels of cotton, only hollowed at the top.

MAMMA. Now, if the fishes were made with one long bone in their backs, instead of being furnished with a spine, they could never bound about in the water as they do, and sometimes bend back their tails to meet their heads.

EMILY. Then, mamma, are the little lumps which I feel all down the middle of my back, the joints where these pieces are united?

MAMMA. Yes; and if you press your fingers upon one of them, whilst you bend forward, you will find how easily they enable you to do so.

JANE. How very curious it feels!

MAMMA. You understand now, how your head is supported. We will therefore return to the top of

the spine, and find out how the upper limbs are joined to it. You can distinctly feel a strong bone on your chest, which is called the Sternum or Breast-bone, which corresponds to the spine behind, leaving a large space between them.

FRANK. Oh, yes.

MAMMA. This bone is also formed of different pieces, and is not so long as the spine, part of the body in front having no bone.

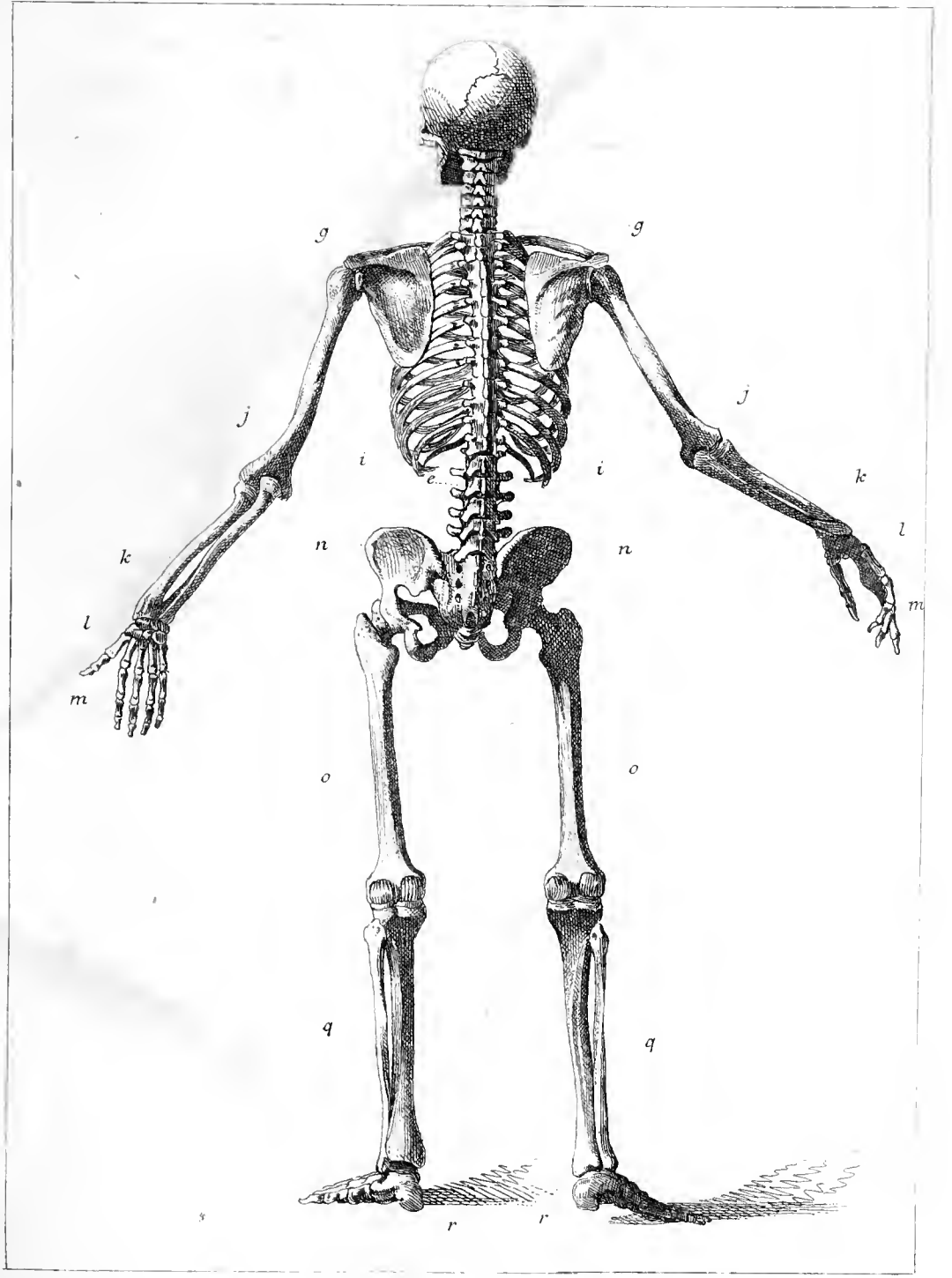
EMILY. How I should like to see a skeleton. Did you ever see one, Mamma?

MAMMA. Yes, my dear, many; and I hope before long, I shall be able to take you all to see one, because you will then understand much better than by any description which I can give, how wonderfully you are made. I can easily show you the picture of a skeleton, which I will now fetch.

EMILY. Thank you, dear Mamma.

JANE. That is the skull, plainly enough. (See Plate I. *a*.)

EMILY. And we can see what mamma said, that there is a hollow place instead of a nose, (*b*.)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FRANK. And there you see, too, that the upper jaw is part of the bone of the face, (*c.*)

JANE. And that the lower jaw is joined to it, by a joint at each end, (*d.*)

EMILY. And there is the spine, (*e.*), with its vertebræ.

JANE. And the sternum, (*f.*) It is not half so long as the spine.

FRANK. It would have been very much in the way if it had been. We should not have been able to bend any better than I, with my iron bar at my back.

JANE. Mamma, what are these bones which I feel in my neck, and which seem to be joined to my shoulders?

MAMMA. They are called the clavicles or collar-bones, (*g.*), and are united, as you suppose, to the two large bones, which are placed between the arms and the spine. These are put in motion whenever you move your arms up or down.

EMILY. Oh, yes; we can see Jane's very clearly; they are almost like wings.

FRANK. But what keeps our sides from falling in; they feel as firm as possible?

MAMMA. If you examine the picture, you will see that there are seven pairs of bones, (*h*), which are joined to the spine behind, and to the breast-bone before; these are called the true ribs. Below these there are five other pairs, (*i*); these are distinguished by the name of false ribs, and are joined or articulated with the spine behind, and in the front of the body, are each united to the rib above it.

FRANK. How many bones are there between the shoulder and the elbow?

MAMMA. Only one, (*j*), which you see is large and strong; and between the elbow and the wrist, as I before told you, there are two, (*k*), to give the arm greater ease, in performing the many purposes for which it was designed.

JANE. I suppose that the wrist is only a single joint, is it, mamma?

MAMMA. On the contrary, it contains eight bones, (*l*).

JANE. Do you mean eight in each wrist?

MAMMA. Yes; and in the hand and fingers nineteen (*m*); so that the number of bones, after the termination of the arms, is—how many?

JANE. Let me try and find out:—Nineteen and nineteen are thirty-eight; and eight, forty-six; and eight more, fifty-four. Oh, mamma, what a number!

FRANK. What pains God has taken, to make us move pleasantly and comfortably; and yet we do not know that we have all these curious bones, until we are told about them.

MAMMA. You are now acquainted with all the bones, in the upper part of the body. To the lower part of the spine, you see there are two large strong bones united, (*n*); these are called the hip-bones. And what is joined to them?

EMILY. The bones of the thighs, (*o*.)

JANE. What is that curious bone that seems to stick on at the knee, and what can it be for?

MAMMA. It is called the patella or knee-pan (*p*), and is fastened over the place where the thigh-bone joins those of the leg. This is necessary, in order to prevent the frequent accidents which would otherwise arise to that part, because it is so liable to blows, and is also so much used in walking, jumping, and in every movement of the legs.

Front view of the Knee.

FRANK. What a nice contrivance! and see how very strong the bone of the thigh is, at the end of it.

EMILY. And so is the top of that great bone in the leg.

JANE. Are there two bones in the legs (*q*) for the same reason, that there are two in the arms?

MAMMA. Yes; and also to give them additional strength; for the whole weight of the body in standing, rests upon them, and on the feet.

FRANK. How very strong the bone of the heel seems to be (*r*).

MAMMA. It is so; the ankle corresponds to the wrist, and the form of it is somewhat similar; and so do the toes to the fingers; only, as they are not wanted for the purpose of holding things, but only to assist in carrying the body, one of them is not separated from the rest, as is the case with the thumb. I have now given you an account of our bony structure, which is together called the skeleton, from a Greek word which signifies *to dry*. At some future time, I will try and explain to you something more of the manner in which we are made.

FRANK. Thank you, mamma; I hope it will be soon. I long to hear more about it.

MAMMA. I have told you enough to make you wonder, at the astonishing love and kindness of God, who has taken such care to fit us in every way for performing all the ends for which we were created; and think how he must watch over us continually, to prevent all those bones from getting out of their places; for whenever this happens, it causes extreme pain and suffering.

EMILY. Are all our bones solid, mamma?

MAMMA. No, my dear; they would be inconve-

niently heavy if that was the case; they are therefore so contrived, as to be the means of containing and preserving different substances. The spinal marrow, for instance, which is a continuation of the brain, is lodged in the spine; if it was not so strongly protected, our lives would be in continual danger. The bones of birds contain a great deal of air, which contributes to make their bodies very light, and enables them to mount so high. But I must not now enter upon this subject, as you will understand it better, when I tell you about other curious parts of our frame.

You see into what a long conversation one short question has led us; so for the present good bye.

Conversation II.

Frank. You promised, mamma, to tell us more about the bones, which you said were hollow, and not solid,—are there any other reasons besides those you have given us, for their being so made?

Mamma. Yes; had the earthy matter, or phosphate of lime, of which they are composed, been all formed into one solid slender bone, instead of being enlarged into a hollow tube, they would have been much more liable to break than they are now, and would not have been so capable of resisting pressure or violence.

Frank. Yes; I see that it would be so.

Emily. But are the parts of the bone which are like the walls of it, quite solid?

Mamma. No; they are porous, as are almost all substances.

JANE. What do you mean by porous, mamma?

MAMMA. Pores are small holes, which are found on the surface of bodies. Even stones, though they seem to be so hard, have pores in them.

JANE. But I suppose we have no pores, have we?

MAMMA. Yes; we are covered with them, and, with a microscope, you could easily see that your skin was full of holes.

JANE. How strange!

MAMMA. But to return to the bones. They have blood-vessels, nerves, and absorbents, and are covered with a strong membranous substance for their protection, called the periosteum.

JANE. Are bones ever made into anything?

MAMMA. Yes; they are employed for many useful purposes; and perhaps you will be surprised when I tell you, that medicines are also made from them.

EMILY. Oh, mamma, which are they?

MAMMA. Hartshorn and sal volatile: lamp-black is also obtained from bones.

EMILY. But I do not understand how these bones move about.

MAMMA. No; I have not yet explained it to you. Our bodies you know, are covered in every part by what we call flesh. This is formed of muscles, which consists of a soft and fibrous substance, of a red colour. They have the power of expanding, that is, of being stretched out; and of contracting, that is, of being drawn into a smaller compass than they usually occupy.

EMILY. But how do they help us to move the bones?

MAMMA. They are fastened to them, though not immediately; because, if a broad, thick, muscle was fixed to a bone at a joint, it would look very clumsy.

EMILY. How is it done, then, mamma?

MAMMA. By something called a tendon: this is a strong, thick cord, fastened at one end to a muscle, and at the other to a bone, so that the muscle pulls this, and it moves the bone.

JANE. I understand, mamma, just as I tied a piece

of string to my cart the other day, that I might drag it more easily.

MAMMA. Just so; the muscles also greatly contribute to the beauty of the form, as they fill up the spaces between the bones, and give a rounded appearance to those parts, where there would otherwise be either a hollow or a point.

FRANK. Then, whenever I want to move, do I pull some muscle or other?

MAMMA. Yes; but you generally pull several.

EMILY. Now let us think: When we walk, or jump, or take hold of any thing, or lift it, or carry it, do we do those things by the help of our muscles?

MAMMA. Yes; but you are continually moving them, even when you are not employed in making either one or other of these more violent movements.

JANE. Are we, mamma?

MAMMA. Yes; at this very instant I saw you use some in the upper part of your body, and some a little below them, and some a little lower still.

EMILY. Where could they be?

MAMMA. Look steadily in Jane's face, and you will soon see her use the same again.

EMILY. Was it in moving her eye-lids up and down?

MAMMA. Yes; and there is another motion we are all constantly performing by the same instruments, which you scarcely perceive except you are reminded of it.

FRANK. I cannot think what you mean, mamma.

MAMMA. It is the action of breathing to which I refer: the chest, which you see move every time you breathe, is lifted up and down by muscles.

EMILY. Is it really? But we never make those muscles work, as we do when we put out our hands, or take hold of any thing?

MAMMA. No; and therefore some persons divide the muscles into voluntary and involuntary,—that is, those which are moved by the will, and those which move of themselves. But now guess, what is the third thing which I said Jane had done at that moment?

FRANK. Do, tell us, mamma.

MAMMA. No; I had rather you would try and find out for yourselves.

FRANK. Whereabouts was it?

MAMMA. Between the eyes and the chest.

EMILY. Was it opening her mouth to speak?

MAMMA. Well, that was another use of the muscles I had not noticed; but it was still another. What did you say she opened her mouth for?

FRANK. To speak; surely we do not speak by the use of muscles: I thought we spoke what came into our minds?

MAMMA. So we do; but dumb persons have also thoughts come into their minds, though they cannot utter them; but it is by the help of muscles that the parts of your throat are so forced together or opened, as to produce different sounds, which express the thoughts you want to tell to some other person.

FRANK. Oh, how very wonderful! But then, mamma, I do not think a thing, and then say to some muscle,—"Move, and let me say this,"—but they seem to do it of themselves. No more I do when I jump or run,—what is it makes them move?

MAMMA. My dear child, you have asked a very difficult question: all we know is, that our will influences our motions. That it does so in speaking is evident; for why does a man speak in a loud tone when he is angry, and in a calm and gentle one when he is happy and pleased? The understanding, which is supposed to influence the will, it is thought, resides in the brain, and to convey its commands to the muscles, through the medium of the nerves; but we know so little about our minds, or the spiritual part of our natures, that the more we try to search out its wonders, the more we must feel that we are entirely ignorant of them.

EMILY. I wish I knew every thing; I cannot understand this at all. But why do some muscles move when we wish them, and others go on doing so whether we wish it or not.

MAMMA. It is not difficult to discover the reason of this wise plan: if your breathing, for instance, depended on your will, you would never be able to go to sleep; for, as soon as you did, you would cease to breathe, and then you would die.

EMILY. Yes, mamma, certainly; and if we had to

think, every time we had to lift up or shut our eyelids, we should soon be tired.

MAMMA. But there are some other things for which you have to use your muscles, which perhaps you never thought of.

FRANK. What are these, mamma?

MAMMA. In sitting, standing, kneeling, stooping, or in placing your body in any position, you have to employ different muscles; and also in chewing and swallowing your food; indeed, it would be endless to enumerate all the various purposes to which these valuable contrivances are put.

FRANK. Are muscles great thick things, all in one piece, like bone?

MAMMA. No; they consist of bundles of fibres, or threads, which are united together: they, as well as the bones, have arteries, veins, absorbents, and nerves.

FRANK. What are nerves, mamma?

MAMMA. They are solid cords, either rounded or flattened; they are sometimes fibrous, consisting of a soft, white substance; they are almost all of them

connected, either immediately or remotely, with the brain, and are always in pairs.

EMILY. Mamma, you said that the tendons were cords, — are the nerves made to answer the same purpose, that of fastening the muscles to the bones?

MAMMA. No; they seem, as far as their peculiar use can be discovered, to be the organs of sensation; those which cause feeling, or the mediums through which the different senses of seeing, tasting, smelling, hearing, and feeling are exercised.

JANE. But, mamma, my nose is not a nerve, is it? and I smell with my nose.

MAMMA. You are right, that your nose is not a nerve; but there are nerves in it, which enable you to perceive the different odours of flowers, and of other things; and it is only when the odoriferous particles of the flowers touch those nerves of your nose, which are called the olfactory nerves, that you discover the difference between one smell and another.

EMILY. Then, mamma, when we feel pain, is

it because there is something the matter with our nerves?

MAMMA. Yes; for though the disease may not have at first been in the nerves, they are affected by it, and cause the pain we suffer. The toothache, for instance, is occasioned by the decay of the bone; but until the nerve is exposed there is no suffering, and this ceases, as soon as the fine thread, or nerve, is broken or destroyed.

EMILY. How nice it would have been if we had been made without nerves, we should then have had no pain.

FRANK. But think, Emily, would you like to be deaf and blind, and have no smell, or taste, or feeling, just that you might escape having pain now and then?

EMILY. Oh, no, brother! I forgot that we should lose all those things by being without nerves.

MAMMA. The marvel is, my dear children, that we should endure so little pain, with such innumerable sources of it as we possess; for these delicate nerves are found in every part of our bodies.

FRANK. It is, indeed, mamma; but I suppose they are well protected?

MAMMA. Yes they are, and the more delicate ones peculiarly so; especially the optic nerve, which is that by which we are enabled to see. I must not, however, omit to tell you of some other things, which are provided for the greater security of our bodies from injury and dislocation.

FRANK. What are these, mamma?

MAMMA. They are white, hard, solid, inflexible substances called ligaments, which fasten the bones securely, and keep them in their right places.

EMILY. How wonderful it is that there are so many contrivances to hold our frame together.

MAMMA. There is another very important thing which I have not yet mentioned.

JANE. Another mamma, what can it be?

MAMMA. The membranes.

EMILY. What are they?—I shall scarcely be able to remember the names of so many things.

MAMMA. Membranes are thin sheets of animal substance, which are spread over every portion of the body.

FRANK. And for what purpose?—I thought we were covered up enough by the muscles, and that we should only hear of the skin besides.

MAMMA. The membranes serve very important purposes, and you would greatly miss them if they were wanting in your frame,—they form linings for some parts, and coverings for others. Those membranes, whose office it is to line any of the cavities, (as, for instance, the cavities of joints, or that of the chest), are furnished with what are called exhalents and absorbents. The former supply a fluid in sufficient quantity to moisten their surfaces, and the latter prevent its collecting, by again removing it. When the body is in a healthy state, there is an exact balance preserved between the two.

EMILY. This is very wonderful! But you said that the membranes formed coverings as well as linings.

MAMMA. They do so; there are membranous coverings to the bones, which are supposed to supply them with nourishment, by means of the small vessels with which they abound: they are of a fibrous texture.

FRANK. Has any particular name been given to them?

MAMMA. Yes, the periosteum; from two Greek words, signifying around a bone. The membrane covering the skull, is called the pericranium; and the heart is enclosed in a membranous bag, called the pericardium.

FRANK. Then, mamma, I suppose the word pericranium means *around a skull,* and pericardium *around a heart?* Am I right?

MAMMA. Yes, my dear.

FRANK. It seems almost endless to describe all the wonderful parts of our structure.

MAMMA. It does, indeed.

EMILY. Mamma, you said you would tell us about the skin. I suppose that it is simple enough; it is only like a glove, drawn over all the things you have been telling us of?

MAMMA. If you were right, when we had a blister raised on our skin, and it peeled off, we should then see the muscles; but that, you know, is not the case.

EMILY. Oh, mamma! surely there is nothing more between the muscles and the skin?

MAMMA. But what do you think of our being provided with three skins?

FRANK. Three skins, where are they?

MAMMA. Each one is drawn over the other, and fits so closely to it, that they seem to you as one.

EMILY. Well, I should never have thought that there was more than one, would you brother?

FRANK. No, indeed: are they called by different names, mamma?

MAMMA. Yes, my dear; that on the outside, with the nails which belong to it, is called the cuticle or epidermis; the second is called the rete mucosum; and the third the true skin, cutis, or dermis. Let us just recal the principal things of which I have now spoken to you; and afterwards, I wish you each to write from memory all that you can recollect of our conversation. We spoke first of —

FRANK. The nature of the bones.

EMILY. And the purposes to which they were put after death.

MAMMA. And next?

FRANK. Of the muscles, and the various ends they answer in enabling us to move the bones.

EMILY. And the tendons, you said, were fixed between the two.

JANE. And you told us about nerves.

FRANK. Which were cords connected with the brain, and by which we feel.

MAMMA. And what else did I explain to you?

FRANK. About the ligaments, which tied the bones together.

EMILY. And then the membranes, which made both coverings and linings to parts of the body.

JANE. Then I remember the last thing, and that was the skin; and you said we had got three skins.

MAMMA. Very well. When you have written down all you can, I will correct it for you.

FRANK. And when we quite understand this, will you tell us more about the same subject?—I do think it so very interesting.

EMILY. Pray do, dear mamma.

MAMMA. I shall be much pleased to comply with your wish at a future opportunity.

Conversation III.

on the circulation of the blood.

Mamma. As you were pleased, my dear children, with what I told you about our bony structure, and about the muscles, tendons, and nerves; I think you will still better like the subject I have thought of to explain to you to-day.

Frank. What is that, mamma?

Mamma. The manner in which the blood circulates through our bodies.

Frank. That is just what I have been wishing to know about, and wondering how it could be contrived.

Emily. Is there not a great deal of blood in every person who is alive?

MAMMA. Yes, there is; and it is kept perpetually circulating, by means of tubes called blood-vessels, which are found in every part of our frame; they are immediately connected with the heart, which is the source from whence they all proceed.

EMILY. But I have not the least idea what blood is, or how it is made.

MAMMA. The food which we eat is chewed or masticated, and afterwards swallowed: it is then received into the stomach, where it is prepared, by digestion, into a state fit for the nourishment of the body. Here there is a curious fluid placed, which changes it into a substance called chyme, which, passing into the small intestines, is there turned into a milky liquor called chyle. This is the fluid matter from which blood is formed.

EMILY. But, mamma, does all that process go on with everything we eat?

MAMMA. Yes, my dear; and very much more, which is too minute to be now described to you.

JANE. How wonderful! What sort of a thing is the heart; and what has it to do with the blood?

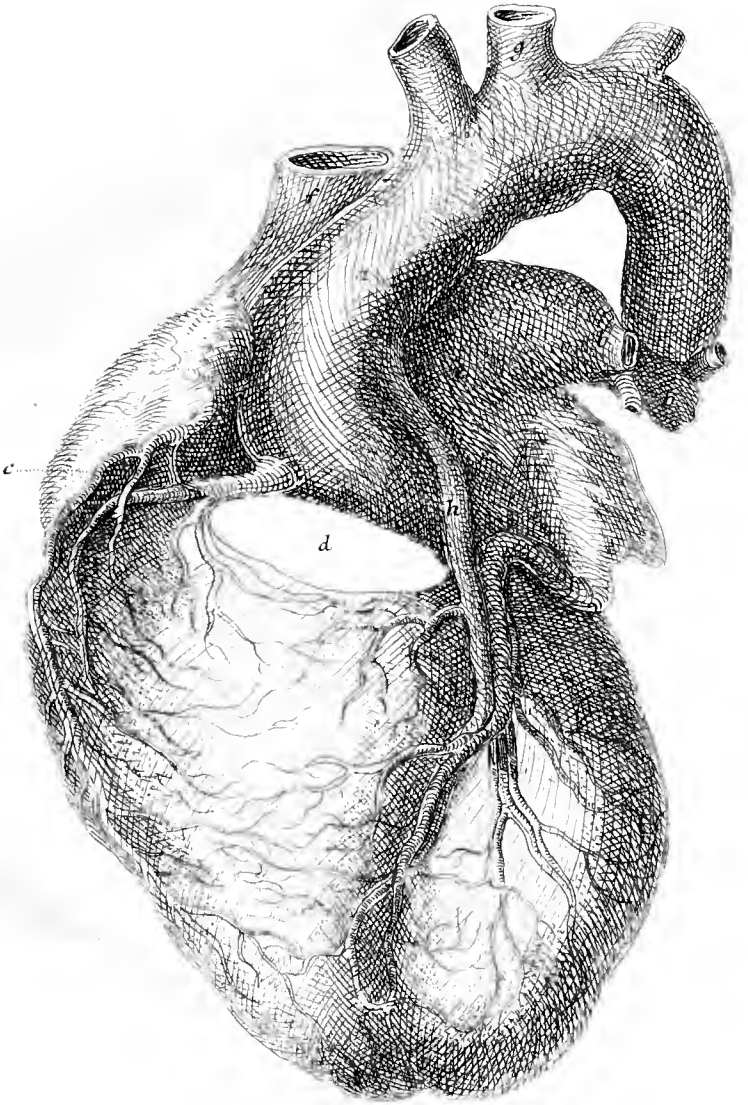
MAMMA. It is properly a large hollow muscle, divided into two distinct parts; the one for sending the blood through the lungs, the other for sending it over the body. Each side of the heart has two great cavities, which are called the auricle and the ventricle. The latter is surrounded with muscular fibres, the use of which is to contract, so as to throw the blood out of this part, or to expand the opening so as to admit it. The ventricle, on the left side, has an opening into a large tube called the aorta, (Plate, II. *a*), or great artery, which, sending off an immense number of branches, carries the blood to every part of the body. I have told you before what covers the heart.

FRANK. I remember; a membrane called the pericardium.

MAMMA. Yes; that is a membranous bag made of the strongest substance of that kind found in any part of our frame.

FRANK. What is the other thing, which you called the auricle?

MAMMA. That is also a cavity, which opens at


g
f
c
h
d

one end into the pulmonary veins, (Plate, II. *b*), that is, those which are connected with the lungs, about which I will tell you presently; and at the other, it opens into the ventricle; but there are valves or doors which divide one from the other, and prevent any blood from passing from thence into the auricle.

Emily. What is the difference between a vein and an artery?

Mamma. The arteries are those vessels which convey the blood *from* the heart all over the body; and the veins are the vessels which bring it back to the heart again.

Emily. Are the arteries of the same size everywhere?

Mamma. No; as they reach the extremities they branch out into exceedingly small tubes, so as to carry the blood into the minutest parts; and, having done this, they empty it into very small veins, which meet larger ones, and these again meet still larger branches, till at last, there are only two great tubes, which empty the blood into the right auricle, (Plate, II. (*c*).

EMILY. Why were these tubes called arteries?

MAMMA. Because it was supposed formerly that they contained nothing but air; as they were always found empty, when persons were opened after their death?

JANE. Then, mamma, have we always the same quantity of blood in our bodies?

MAMMA. No; but these tubes are capable of becoming larger or smaller according to what it is requisite they should hold.

EMILY. But what sends the blood out of the heart when it has once got there?

MAMMA. The contraction of the fibres, which I named to you before; this is one of the involuntary motions, which, you remember, the muscles perform.

FRANK. How often is this done?

MAMMA. It depends both on the age of the person, and on the state of their health.

EMILY. How can we tell how often the heart throws out blood?

MAMMA. By counting how often our pulse beats.

If you place your finger, for instance, just above the wrist, you can distinctly feel the throbbing of the artery; and at each of these throbs, a quantity of blood is thrown out.

FRANK. How much, mamma?

MAMMA. In a man, it is supposed to be about two large spoonsful each time; and this takes place, if you feel sixty beats in each minute,—how many times in an hour?

FRANK. Sixty times sixty,—three thousand, six hundred times. Oh! Is that possible?

MAMMA. In a child, the pulse beats much more quickly; sometimes above a hundred times in a minute,—how often would that be in an hour?

EMILY. Sixty hundred, that is six thousand times. How strange, that the heart should not be pained or tired, with having so much work to do constantly.

JANE. Is it employed so all night, as well as all day?

FRANK. If our hearts left off beating, we should die, should we not, mamma?

MAMMA. Yes, dear, directly.

FRANK. But you have only told us about the left side of the heart,—what has the right side to do?

MAMMA. It is formed like the left side, having both an auricle (Plate, II. *c*) and a ventricle. These are employed in throwing the blood into the lungs, through which it is circulated, in a similar manner to that which I have described to you as taking place in the body, and in receiving it again.

EMILY. Will you explain that more fully, mamma, I do not quite understand you?

MAMMA. An artery, called the pulmonary artery, (Plate II. *d*), receives the blood from the *right* ventricle, and carries it all over the *lungs*, just as I told you, the great vessel called the *aorta*, took the blood from the *left* ventricle, and carried it over the *body*.

FRANK. I understand you.

MAMMA. Then the blood collects again into veins which unite, and return it to the left auricle, (Plate, II. *e*). The reason why the blood has to circulate through the lungs is, that it may meet the air, which we take in every time we breathe, and which passes through vessels constructed for this purpose, into the lungs. A certain portion only of this air is taken

into the blood, and air of another kind is given out by it. More than this you cannot understand yet; only I must tell you, that the blood in the veins is of a dark, purple colour, but when it meets the air, it changes into a bright red.

EMILY. Then, are there holes in the blood-vessels, or how do they get the air out of the air-tubes?

MAMMA. No; there are no holes which can be perceived, either in the arteries or in the air-vessels, which always run parallel with them in the lungs; but it is supposed that the blood absorbs, in some way unknown to us, that portion of the air which is called oxygen, and which gives to the blood that red colour which it has after this has happened.

EMILY. Will you repeat to us again, mamma, what you have said about the course the blood takes, —it is so difficult to remember?

MAMMA. The heart is composed—of how many different parts?

EMILY. Of two?

MAMMA. And what does each of these parts contain?

FRANK. An auricle and a ventricle.

MAMMA. Right; and for what purpose is it thus divided?

EMILY. One auricle and one ventricle has to circulate the blood through the lungs, and the other auricle and ventricle circulate it through the body.

MAMMA. Just so; this, then, is the process:—The blood goes first into the right auricle, (Plate, II. *c*), and passes from thence into the right ventricle, which throws it into the pulmonary artery, (Plate, II. *d*), whose office it is to carry it through the lungs. This artery distributes the blood through smaller branches, which empty themselves into the pulmonary veins, (Plate II. *b*), and finally into the left auricle, (Plate, II. *e*). The blood is thrown by the left auricle, (Plate, II. *e*), into the left ventricle which empties itself into the great aorta, (Plate, II. *a*), and from thence the blood is distributed by smaller arteries all over the body. These empty themselves into veins, which bring back the blood to the right auricle, (Plate, II. *c*).

FRANK. Then, mamma, has the blood, after it

has been through the body, to pass into the lungs again?

MAMMA. Yes; every time it is brought back by the veins to the heart.

EMILY. Then, are there two actions of the heart; one to throw the blood into the body, and the other to throw it into the lungs?

MAMMA. No, it is one and the same; so wonderfully is that astonishing machine taught to work.

EMILY. In this picture, mamma, the pulmonary artery does not look like the others, a long continuous tube?

MAMMA. No; it is represented as cut off, that it may not prevent your seeing the other parts of the heart, which would else be hidden.

EMILY. There are a great many other blood-vessels marked in this plate, of which you have not told us the names.

MAMMA. Yes; they are all arteries and veins connected with the heart, which have names given to distinguish them, as (Plate, II. *f*) the superior *vena cava*, and (Plate, II. *g*) the left carotid artery, and

(Plate, II. *h*) the left or superior coronary artery; but it would only perplex your minds, and make the subject too intricate, if I were to enter more into detail, I have therefore confined myself to giving you a general outline.

FRANK. Mamma, there is one question I want particularly to ask,—Did you not say that the blood in the veins was black, and in the arteries red?

MAMMA. Yes, my dear.

FRANK. And when it meets the air, it becomes red?

MAMMA. Yes.

FRANK. Then, when the arteries take the blood over the body, it is red, is it not?

MAMMA. Yes.

FRANK. Then, how does it turn black again, when it gets into the veins?

MAMMA. The oxygen, or vital air, contained in the arterial blood, is supposed to be absorbed, as the blood passes through its course of circulation; so that when it has entered the veins, it is again of its original dark colour. It, therefore, requires to be

sent again through the lungs, to gain a fresh supply of oxygen.

FRANK. Thank, you, mamma, I understand it now; but I have one more difficulty. If there is fresh blood continually made, how is it that the body does not get too full of it?

MAMMA. For this reason: there is always a process going on within us, by which its particles are carried off or absorbed. This is so contrived, that the fresh supply in healthy persons, is just equal to the portion wasted.

FRANK. But how can the blood escape?

MAMMA. Our bodies, as you know, are covered with little holes or pores; and through these, the watery particles of our blood are constantly escaping.

EMILY. Is there water mixed with the blood?

MAMMA. Yes; it contains a large portion of watery matter, which separates entirely from the other particles, when the blood is put in a vessel by itself. Now, let us return to the subject on which we were speaking before.

FRANK. Will you tell us something about the lungs, and where they are placed?

MAMMA. The lungs are placed in the cavity, which, you will remember there is between the spine and the breast-bone or sternum, and they are of a soft spongy texture.

FRANK. Is there more than one lung, mamma, as there is only one heart?

MAMMA. Yes, two; one on the right, and one on the left of the chest, and they contain both air and blood-vessels: that on the right side is divided into three parts or lobes; that on the left side is divided into two lobes, between which is a space, where the point of the heart lies.

EMILY. How are they separated from each other?

MAMMA. Each lung is contained in a strong membranous bag, called the pluera, and the air-vessels which are connected with the wind-pipe, through which, you know, we breathe, run along between the blood-vessels in the lungs, and so give to them that quantity of air which is required to change the colour of the blood, and to render it fit for circulation.

The Lungs.

a a Mediastinum, the membrane which divides the chest into two parts.

b b The ribs cut off, so as to show the inside of the chest.

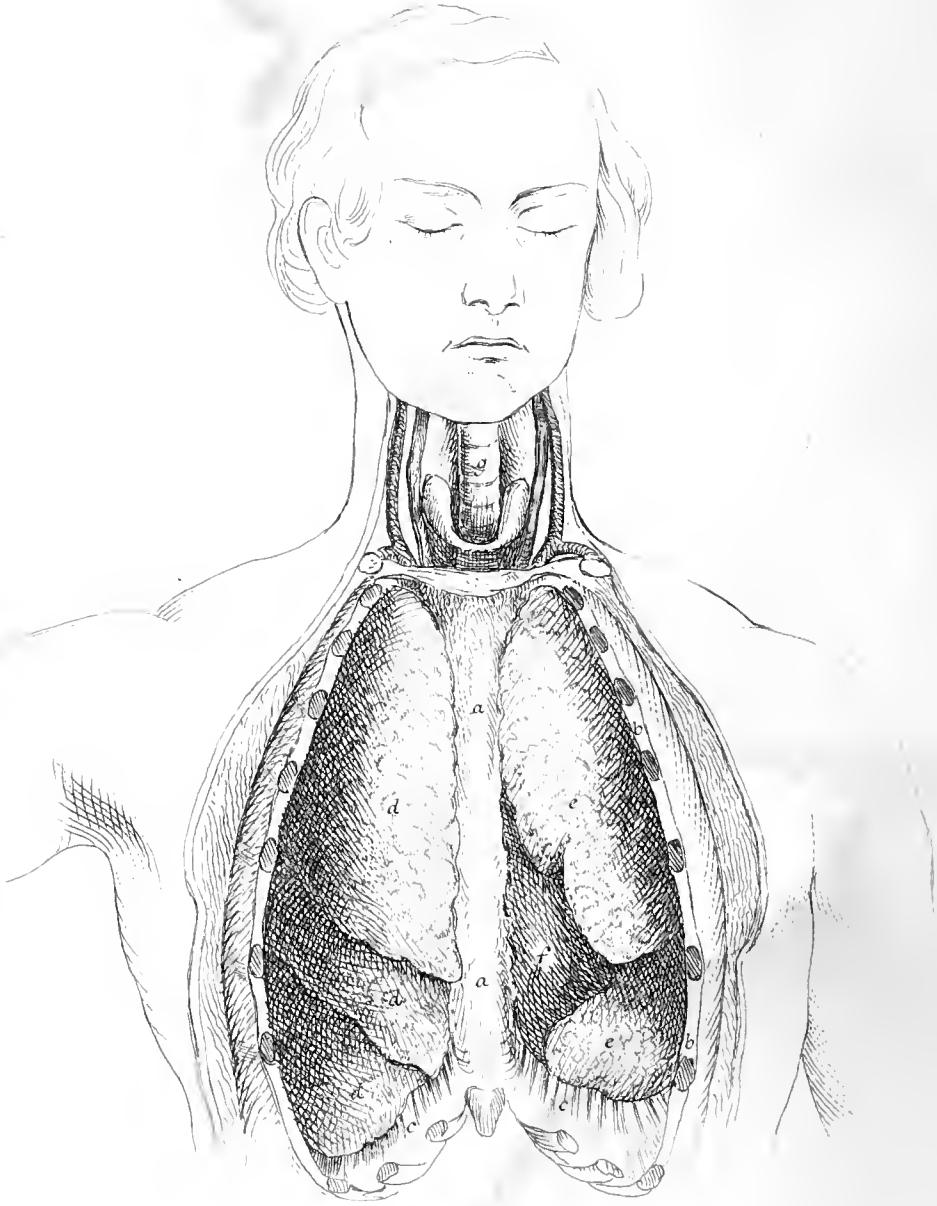
c c The Diaphragm, which supports the thorax or chest.

d d d The three lobes of the right lung.

e e The two lobes of the left lung.

f The point of the heart inclosed in the pericardium.

g The Trachea or Windpipe.



The Lungs

FRANK. How is it, that when the blood is sent back from the auricle into the ventricle, it does not run back again?

MAMMA. There is a curious provision to prevent this, which is, that the one is separated from the other by valves.

JANE. What are those, mamma?

MAMMA. The simplest idea I can give you of them is, that they are like little doors, which, if shut up by a force on one side, continue closed, and cannot be opened by any pressure on the opposite side.

JANE. But, are they made of wood?

MAMMA. No, my dear child, they are membranous; but are not formed of one membrane only, but of several. The valve remains open whilst the blood is passing through the right way, but if any was to flow back, it would lift the door from the side on which it was hanging, and shut up the passage entirely.

FRANK. What a wise plan! how exactly it must answer the purpose!

MAMMA. It does so, completely; and gives us

one of the many proofs we everywhere meet with, of the gracious care God has taken in our formation, to make everything contribute to our safety and comfort.

EMILY. Are the lungs, then, very liable to be hurt?

MAMMA. They are; and it is for this reason that they are so well protected. Can you conceive of any situation in the body where they would have been so safe, as in the hollow, strong box formed by the spine, the breast-bone, and the ribs?

EMILY. They are, indeed, well taken care of.

FRANK. I think that every one who studies these things much must be very pious, and love God exceedingly,—don't you, mamma? They must see more of his wonders than any one else.

MAMMA. It should be so, my dear; but I fear it is not always the case; for we know that no outward things can change the heart; this must be the work of God's Holy Spirit.

FRANK. How was the discovery first made of the circulation of the blood, and who made it?

MAMMA. A very wise author, whose works you

have read, and who wrote very long ago, seems to have known it.

FRANK. Whose works *I* have read, mamma! who can it be?

MAMMA. Yes, a very great man, who, when he was asked whether he would be rich, or powerful, or wise, chose the latter before all the others.

EMILY. Oh, mamma means Solomon; but is there anything in the Bible about the circulation of the blood? I do not remember it.

MAMMA. There is a passage in the Ecclesiastes, which is generally understood to refer to this subject.

FRANK. Do not tell us which it is, mamma; do let us try and find it out.

EMILY looked for some time, and then said,—Well, I do not see anything like that; do you, Frank?

FRANK. No, not yet; but perhaps I may presently. I have got to the tenth chapter, but it may be after that,—is it, mamma?

MAMMA. Yes, it is.

FRANK. Oh, I think I have it in the twelfth; is it not in that account that you told us meant death?

MAMMA. Yes. Which verse appears to you to contain a description of the circulation of the blood?

FRANK. It must be from the sixth to the end of the seventh verse, — "Or ever the silver cord be loosed, or the golden bowl be broken, or the pitcher be broken at the fountain, or the wheel broken at the cistern. Then shall the dust return to the earth as it was, and the spirit shall return to God who gave it."

MAMMA. Yes, that is a beautiful and poetical description of the way in which the blood is thrown out by the heart, which is compared to a cistern, at which a wheel is continually turning, and throwing forth its contents. God, who gave Solomon the spirit of wisdom above all the men who dwelt upon the earth, most probably taught him this hidden thing, amongst the many others in which he instructed him.

FRANK. Was it known then from Solomon's time to the present day?

MAMMA. That is a much disputed point; some suppose that the Greeks and Romans were acquainted with it, from passages which are to be

found in their writings; but at all events, the full discovery was made by a countryman of our own, William Harvey. He was born at Folkestone, in Kent, on April 1, 1578, and died in his 80th year. He lived in the reign of James I. and Charles I., when learning was much more rare than it is at present.

FRANK. Did he find it out all at once?

MAMMA. No, but by slow degrees; and after he was sure that he was right, it was a long time before he published to the world what he had discovered, and not till, after many and repeated experiments, he had ascertained the fact beyond a doubt.

JANE. Did not every one wonder at his cleverness, and praise him much for it?

MAMMA. No, just the contrary; like most other men, who know more than the generality, he was very much persecuted by some, and ridiculed by others.

EMILY. How old was he when he found out about the circulation of the blood?

MAMMA. He was born in 1578, and it is thought that he published his discovery about the year 1616. Now tell me how old he was.

EMILY. Just 38, mamma.

FRANK. He was 38 when he made it known, but mamma said he had found it out long before he made it public.

JANE. Did every body laugh at him?

MAMMA. No; when he began to be known, King James I. paid him great respect, and showed him much favour, and so did his successor, Charles I., who used to go sometimes with his courtiers, to hear him lecture, and to see him prove by experiment what he taught.

FRANK. I am very glad he was not quite neglected.

MAMMA. In the end, he became generally esteemed and beloved; and his name is come down to us as one of the greatest of men, and it will be remembered while time endures. I must not talk to you any more now; but I have told you enough to make you wonder when you think of your own bodies, and of the ceaseless work which is carried on within them, of which we know so little.

FRANK. You have indeed; I do not think we shall easily forget this lesson. Thank you, mamma.

Fig. 1

Fig. 2

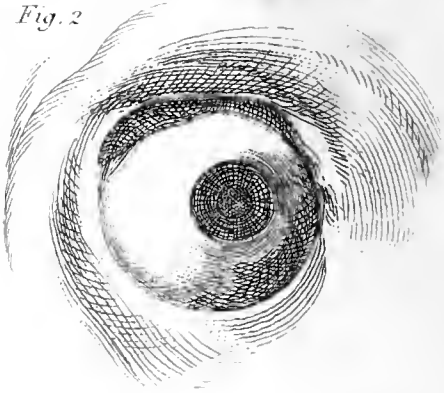


Fig. 3

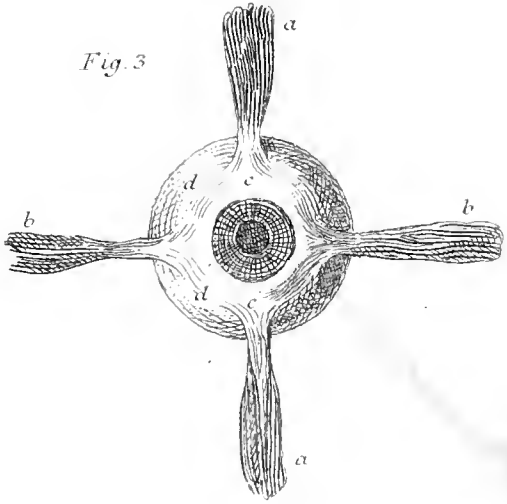


Fig. 4

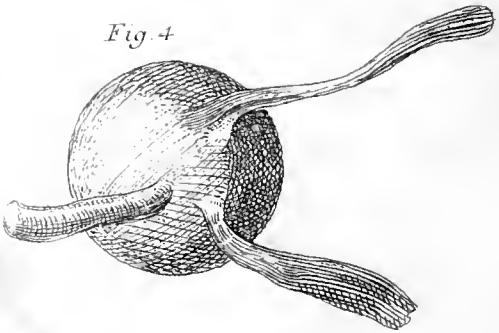
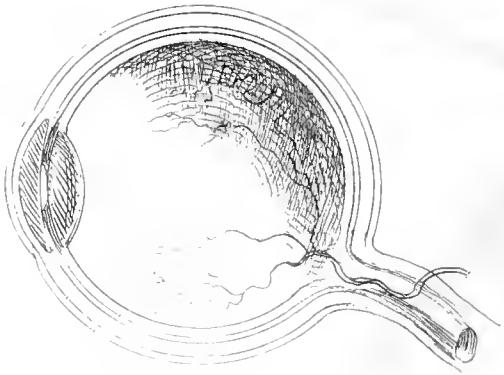


Fig. 5



The Eye

The Eye.

Fig. 1. The Eye in its natural position.

a The Pupil.

b The Iris.

c The white of the eye covered by the Conjunctiva.

Fig. 2. The Eye with the lids cut off.

Fig. 3. The Eye with the muscles extended, by which it is moved in different directions.

a a The muscles by which it is moved upwards or downwards.

b b The muscles by which it is moved towards one side or the other.

c c The Conjunctiva.

d d The Sclerotica.

Fig. 4. The back of the eye, showing two other muscles and the optic nerve.

Fig. 5. Section of the eye, explained, p. 65.

Conversation IV.

on the eye and seeing.

Emily. Mamma, we have all been thinking what we want next to have explained to us, now that we have learned about the circulation of the blood; and we are quite agreed, that we wish most to know how we see, and hear, and smell, and taste, and feel.

Jane. I dare say that this will be easy to understand because the eyes, and nose, and ears are such little things, and so different to the blood, that goes travelling about all over the body, and then back again to the heart.

Mamma. Sometimes very small things are more difficult to explain than very large ones, because they contain as much curious mechanism in a small space as the others do in a more extended one, and this is the case with the organs you have named.

FRANK. We have been trying to make out what part of the eye sees, and whether all of it does, and we cannot be satisfied.

JANE. And how odd it is that such a *little* thing can see such *great* things; for I can look at a house, or a whole street, though my eye is not near so big as the palm of my hand.

EMILY. Yes, or at a great mountain, or miles of country.

MAMMA. I will explain to you the construction of the eye as simply as I can; but many of the questions you have asked, require more knowledge than you possess at present, on various subjects, for you to be fully satisfied about them.

EMILY. It seems, mamma, that the more you tell us, the more there is to know; for we hardly ever ask you anything without your speaking of something about which we were quite ignorant before.

FRANK. Shall we ever know *every thing*, if we study as hard as possible?

MAMMA. No, never; because it takes a whole life to attain very considerable knowledge in one pursuit only. Besides which, new discoveries are so perpe-

tually made, that no one can say that he has learned all that can be known even of one subject. The wisest men are always the most conscious how limited are their attainments.

Sir Isaac Newton, one of the greatest philosophers who ever lived, and who made discoveries of inestimable value, with regard to the principles by which all nature is governed, used to say,—"I do not know how I may appear to others, but I seem to myself to be like a boy playing on the sea-shore, who now and then picks up a smoother shell, or a prettier pebble than ordinary, whilst the great ocean of truth lies all undiscovered before me."

FRANK. That showed real wisdom, mamma; but what do you mean exactly by a philosopher?

MAMMA. Just what you have expressed, my dear; it signifies a lover of wisdom, and comes from two Greek words of that import.

JANE. Do you think, mamma, that there ever was any one who fancied that he knew everything?

MAMMA. Yes; I have heard of one man who was very learned, and had applied himself with so much diligence to the study of languages, that he became

acquainted with an immense number, and at last was so foolish as to think he had nothing left to learn.

FRANK. And what did he do then?

MAMMA. He showed that he had the chief knowledge yet to acquire,—that of himself, as a sinner before God. He was so wicked as to poison himself, when only thirty years of age, from mere weariness of life, though he was awfully unfit to die.

FRANK. And do you know his name, mamma?

MAMMA. Yes; I have often heard him spoken of by some one who knew him well.

But you have asked me to tell you how we see. I must therefore try to give you some idea of the manner in which the eye is formed, though no mere description will be sufficient to explain this clearly to you. The best way to understand it, is to see an eye dissected.

EMILY. What do you mean by dissected, mamma?

MAMMA. A dissection is a cutting or separating the parts, of which a body is composed, one from another. You can then examine each distinctly, and by their being gradually and carefully divided, you

perceive the connection in which the parts stand relatively to each other.

FRANK. Oh, how I should like to dissect an eye; did you ever do it, mamma?

MAMMA. I have seen it done by some one who understood it well, but you could gain no improvement by doing it yourself. Another reason why I cannot explain to you fully about this curious instrument is, that you are not old enough to understand the effect which the form of the different parts of the eye has on objects, in making them appear near or distant. This belongs to a science called optics, which I hope you will learn some time hence. The first thing which I wish you to notice, is the great care which God takes of this precious organ. Where is it placed?

EMILY. In the front of the skull.

FRANK. Was not that a wise place for the eyes? I don't see anywhere else in which they could have been so well put.

JANE. If they had not been so high up, we could not have seen about us,—could we?

EMILY. No certainly; and they would have looked rather funny at the back instead of the front of our heads.

MAMMA. They are also placed in deep sockets or hollows in the skull, that they may be less liable to injury; and how are they protected?

FRANK. By the part of the skull that forms the base of our eyebrows.

MAMMA. Yes; if you feel it, you will find that it stands out a great way, so as to make a roof or shelter.

EMILY. Then there are the lids, too, which cover them up so comfortably, and shut out the light whenever we please.

JANE. And keep shut all night, that we may go to sleep.

FRANK. What can be the use of the eyelids shutting up and down so often?

EMILY. I should think that it was to wipe the eyes clean from any thing that may get into them,—is it not, mamma?

MAMMA. Yes; and also to rest them from the

constant glare of light, which would otherwise give us pain.

JANE. Is there any use in the eyelashes?

FRANK. I can guess what they are for; are they not to form a kind of shade, mamma?

MAMMA. Yes; and also to catch any particles of dust, which might otherwise enter the eye.

EMILY. Then there are the eyebrows, too; can they be of any use?

MAMMA. Yes; they are placed above, to prevent the moisture from the forehead from getting into the eyes.

JANE. The eyes are taken care of indeed!

MAMMA. But this is not all; there is a fluid which is always keeping them moist and clean.

EMILY. But, mamma, you have not told us yet *how* we see. Is it with the coloured part, or with that black spot in the middle?

MAMMA. That black spot in the middle is nothing but a hole.

EMILY. A hole, mamma?

MAMMA. Yes; and through it the objects which

you see are reflected on a nerve, which is called the optic nerve, and from thence sensation is conveyed to the brain. You remember, I hope, what I told you about the nerves?

FRANK. Yes; you said that they were white threads or strings, sometimes flat and sometimes round, which were all connected with the brain, or the spinal marrow, and that they were the things which make us feel.

MAMMA. You are right. The optic nerve proceeds directly from the brain, and expands round the back of the eye. So you can easily understand why any injury done to your eye would cause you so much pain.

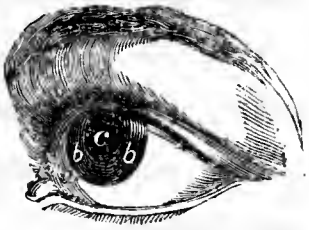
FRANK. Yes; but still I cannot think how such great things as I see can come through such a little hole.

MAMMA. You do not see the things themselves, but only the reflection of them.

EMILY. Do not I see you, mamma?

MAMMA. No, only the reflexion of my image; just as when you look in a mirror, you do not see

yourself, but merely the reflexion of your face in the glass. It would puzzle you, if I said more on this matter at present. I will, therefore, tell you further of the eye itself. The coloured part, surrounding the pupil, is called the Iris, (*b*).



FRANK. I can guess why it is called so; is it not because that word means a rainbow, and this is the coloured part of the eye, and sometimes looks as if it had many colours in it?

MAMMA. Yes, it is; and the hole in the middle of it is the pupil, (*c*).

EMILY. Is the pupil always of the same size?

MAMMA. This you may easily find out for yourself; look at your sister's eyes, now she is turned to the light, how do the pupils look?

EMILY. Very small indeed.

MAMMA. Now go with her into a part of the room where she will be in the shade, and tell me whether they appear at all changed.

EMILY. Oh yes, they are a great deal larger.

MAMMA. That is because the iris has the power

of contracting; that is, of drawing closer the opening through which the rays of light pass to the brain, whenever these are so vivid, that they would cause pain. It always does so when the eye is in a healthy state, but in some diseases it loses this power. Do you observe that the eye in front is not flat, but rounded?

EMILY. Yes, mamma; is it the same in all persons?

MAMMA. In all it is rounded, but not always equally so. Those whose eyes project very much, are near-sighted; but the full explanation of the reason *why* it is so, belongs to the science I spoke of just now.

FRANK. Is the eye flat at the back?

MAMMA. No, it is a round ball sunk in a deep socket; but the ball is not equally round, as the circular projection in front is much greater than behind. The whole is composed of several different substances, called coats, or humours, each intended to answer some valuable end, in enabling us to see distinctly and pleasantly the various objects by which we are surrounded.

FRANK. I think, mamma, there seems to have been more care taken of the eye than of any other part of the body.

MAMMA. Yes, on account of its being of such immense importance to us, and because from its situation, and its delicate texture, it is so liable to be hurt. Do you remember in the Scripture any texts in which God speaks of the care he takes of his people, comparing it to the tenderness we feel for the eye?

FRANK. I think there is one text, mamma, in Deuteronomy. Will you tell me whereabouts it is?

MAMMA. You will find it in one of the latter chapters; begin at the 30th, and look till you meet with it.

EMILY. Oh, I have it; it is in Deut. 32, x.

MAMMA. Read the 9th verse also, which shows the connexion.

EMILY Read, — "For the Lord's portion is his people: Jacob is the lot of his inheritance. He found him in a desert land, and in the waste, howling wilderness: he led him about, he instructed him, he kept him as the apple of his eye."

FRANK. Is there not a text, too, like this in the Psalms?

MAMMA. Yes, and in one of the minor Prophets. I should like you to find them both; that in the Psalms is somewhere before the twentieth.

FRANK. Here it is, mamma, in Psalms 17, viii. — "Keep me as the apple of the eye: hide me under the shadow of thy wings."

JANE. Now let me find the other; do tell me, mamma, where I may look for it.

MAMMA. It is in the second chapter of Zechariah.

JANE. Oh, here it is; it is in the eighth verse, — "For thus saith the Lord of Hosts, after the glory he hath sent me to the nations which spoiled you, for he that toucheth you, toucheth the apple of His eye."

MAMMA. Now, then, whenever you feel how careful you are in preserving your eye from harm, and how suddenly you shut down the lid whenever you see anything coming that may give it pain, you will learn how tenderly God takes care of his people, how he is ever watching over them to do them good

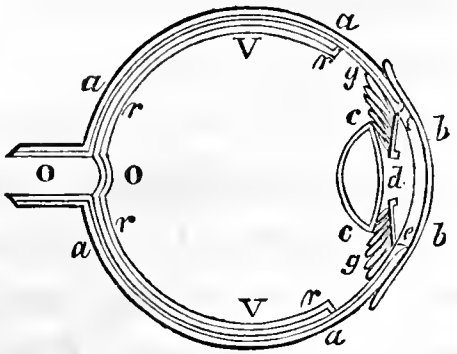
"lest any hurt them." He says, "I will keep them night and day."

FRANK. Then, Mamma, the better we understand how the eye is made, the more we shall be able to see how good God is, and how kind to us.

MAMMA. Yes; every thing which we hear of His marvellous works, teaches us this lesson more plainly.

FRANK. When you said that the pupil was a hole, and not a separate part of the eye, I did not understand whether you meant that it was hollow all the way, and open at both ends; because, if I look at you, it seems to me, that there is no hole on the surface.

MAMMA. You are right; the eye-ball is covered externally, with the exception of one-sixth part, by a coat which is called the *Sclerotica*, (*a a*,) which is a dense, hard, fibrous membrane, and has its name from that circumstance, as *sclerotica* means *hard*. The part which



covers the other sixth of the eye-ball, is the *Cornea*, (*b b*), which is firm and resisting in its structure, like the *sclerotica*, and is fitted to protect the exposed anterior portion of the eye, whilst its perfect transparency allows the free passage of light into the interior of the globe, and first converges the rays of light. These two coats are so firmly united, that they may be considered as one continued investment of the eye, and as forming a kind of case for lodging and protecting its more delicate and essential structures.

EMILY. Then the eye is like a watch, for it has case within case?

MAMMA. Yes; but you have not heard of them all yet; for there is another coat called the *Choroid*, which is spread uniformly within the *sclerotica*, and reaches to the margin of the *Cornea;* the inner surface of it is covered with a black varnish.

EMILY. We have not yet come to the iris?

MAMMA. No; that is the next part to be considered. It is of considerable importance, and is highly curious, from its peculiar motion, and its office of regulating the quantity of light admitted into the

eye. This membrane is placed behind the *cornea*, (*e e*), and seems like a continuation of the *Choroid Coat*.

EMILY. Where, then, is the coloured part of it?

MAMMA. In the anterior or front part. The colour, you know, varies greatly in different persons.

JANE. It does, indeed. I think I never saw two persons whose eyes were exactly alike.

MAMMA. The iris is perforated, or has a hole in the middle, forming the pupil, (*d*). The posterior surface is called the *Uvea*, from the Latin word *uva*, which means an unripe grape; because in brute animals, which the ancients chiefly dissected, and from which they gave names to the parts which they discovered, it is like an unripe grape.

JANE. What did you mean, mamma, when you spoke of the posterior surface?

MAMMA. It means the surface at the back of the eye; it comes from the Latin word *post*, which means *after*.

EMILY. If the pupil is only a hollow, why does it always look black?

MAMMA. From the dark colour of the *choroid coat*, of which I have just spoken; but in some animals, the choroid is not so dark, and then the pupil is lighter also.

EMILY. What is the colour of the *sclerotica?*

MAMMA. It is of a dead white, and colourless, and at the anterior part of the eye, is in connection with a membrane called the *Conjunctiva*, which gives to that part the appearance, which is commonly called the white of the eye.

FRANK. Are these coats of the same nature as any thing you have described to us before, Mamma?

MAMMA. Yes; they are membranous, and so form a strong casing and protection for the moveable part of the eye.

EMILY. What makes the eye turn from place to place?

MAMMA. It is provided with several pairs of muscles, which pull it in whatever direction we want to look. But I have not yet told you of another coat; it is called the *Retina*, from the Latin word *rete*, a net; and this is the last coat proper to the eye. It is white, soft, and tender; and resembles in

semi-transparency and colour the ground-glass of which ornamental lamps are made; it lines the inner surface of the coats of the eye, (*r r*), and is a continuation of the optic nerve, which comes, as you know already, from the brain, and passes through a small opening in the sclerotic and choroid coats, (*o*). The *retina* is the membranous expansion of the optic nerve, upon which the images of external objects are painted or reflected; and thus the sensation of seeing is produced on the brain.

Emily. Do you mean, mamma, that the optic nerve is like the hollow stem of some flowers, the top of which spreads out into a kind of cup?

Mamma. Yes; that is a very good illustration of its form. I have before mentioned the *conjunctiva* as one of the membranes; I shall now tell you a little more about it. It ought, strictly speaking, to be considered as one of the coats belonging to the globe. It is a thin membrane; one portion of it lines the inner surface of the eyelids, and turns over the globe, and covers two-thirds of the eye; that is to say, the anterior portion of the sclerotica and cornea.

EMILY. You said, mamma, that besides these three coats, of which you have told us, there were other things in the eye.

MAMMA. Yes; these are called *Humours*. There are three, the vitreous, the crystalline, and the aqueous. The second is generally called the crystalline lens, because it performs the office of a lens or glass, for reflecting objects.

FRANK. In what part of the eye are the humours placed?

MAMMA. The vitreous humour (V V), fills up the hollow of the cavity which is made by the retina; the *crystalline* is a part of this (*c c*); and the *aqueous*, (which means watery), is a small quantity of clear water, which occupies the space between the *crystalline humour* and the *cornea;* here the *iris* is placed.

EMILY. I suppose the iris had such a soft bed, that it might move about the more easily.

MAMMA. Yes; had it been situated otherwise, it could not have dilated and contracted as it does, without inconvenience, and we are not conscious, now, from feeling it, when it moves.

EMILY. But of what further use are these humours?

MAMMA. They perform different offices, in enabling us to see clearly. If any disease or injury happens to only a part of the eye, the sight is affected.

EMILY. You said that there were muscles, and nerves, and arteries, and veins, and vessels called absorbents, all over the body,—are there any belonging to the eye?

MAMMA. Yes; there is an adequate supply of each.

FRANK. But how exceedingly small they must be, to go into such a little space.

MAMMA. Yes, they are very minute; and yet, as carefully and exactly made, and as much adapted to answer the precise purpose for which they are intended, as the large ones which are found elsewhere.

EMILY. I want to know where it is that tears come from when we cry?

MAMMA. They come from what is called the *Lachrymal Gland*, which is situated within the external angle of the orbit of the eye; its office is to

secrete the tears, which are conveyed to the eye by little tubes or ducts, six or eight in number; they open upon the internal surface of the upper eyelid. The fluid which moistens the eye, and the tears which do not flow down the cheeks, are conveyed by a little apparatus into the nose. There are two small orifices or openings, one of which is seen at the extremity of the eyelid, near the inner angle or corner, which are the external commencements of two small tubes, which go towards the inner angle of the eye, and then terminate in a little bag, called the lachrymal sea, which is about the size of a horse-bean, whence a tube descends into the nose, and is called the nasal duct. Between the two orfices above mentioned, is a reddish oblong body, like a wart, called the *Lachrymal Caruncle*, which may be distinctly seen by looking at any eye. Tears belong to a class of things called secretions, and processes which form these are constantly going on in the body, besides all the other operations, about some of which I have told you, such as the circulation of the blood. Try, now, and enumerate the principal things you have learned about the eye.

FRANK. It is placed in the best situation possible, both for seeing and for safety.

EMILY. And is protected by the skull, the eyebrows, eyelashes, and eyelids.

FRANK. It has four coats, the sclerotica, the cornea, the choroid, and the retina.

EMILY. And three humours, the vitreous, the crystalline, and the aqueous.

JANE. I remember about the coloured part of the eye; it is called the iris, and has a little round hole in it called the pupil.

MAMMA. You are right, Jane; I am glad you remember that.

FRANK. The retina is the expansion of the optic nerve, which forms a sort of hollow cup, round the eye, after having gone through a hole in the sclerotica and cornea, and the things which we see are reflected upon this through the pupil.

MAMMA. And where are the humours placed?

FRANK. The vitreous next to the retina; then the crystalline, which you said was called a lens; and then the aqueous; and the iris was placed in this humour.

Then, mamma, after all, we do not see with our eyes?

Mamma. No, my dear; they are but the instruments, or means of our seeing. You do not see with spectacles or a magnifying glass; yet they both serve to make objects more distinct to you. The eye, from being a living thing, though it performs the same kind of office, does it much more perfectly; and it was from observing the manner in which the eye was formed, that men learned to make glasses or lenses for various purposes.

Frank. Then the brain, and the nerves going from it, are the only things which feel?

Mamma. Exactly so; and now let us remember what we owe to the possession of sight; what a means our eyes are of making us happy. Every day they bring to our knowledge something new, and open to us fresh sources of pleasure.

Emily. When we think what a very delicate organ the eye is, it seems remarkable that so few persons, comparatively, should lose their sight, and that this faculty is preserved to us for so many years.

Frank. And how very few are born blind!

JANE. But, mamma, why are any blind, and how is it that we have any pain at all,—it would be much pleasanter to be without it?

MAMMA. Pain and suffering are the consequences of sin. If man had not sinned, he would have been always free from them. I do not mean that every pain we feel is the immediate punishment of some sin we have committed, for it is not so; God sends sometimes the bitterest sufferings to some of his holiest servants. And why is it so, Frank; what does he tell us it is for?

FRANK. He says that he does not willingly grieve them, but for their profit; that they may be partakers of his holiness.

MAMMA. Yes, it is for that end; that He may wean their hearts from a sinful and dying world, and draw them nearer to himself. And when this end has been answered, He takes them away to dwell for ever in a land "where the inhabitant shall no more say, I am sick; for the people that dwell therein are forgiven their iniquity."

Conversation V.

THE SAME SUBJECT CONTINUED.

Emily. Since you told us, mamma, of the way in which the eye is formed, I have thought a great deal more of it than I did before. I never used to remember that I had eyes, except when they gave me pain; but now, I often recollect what strange things are going on in them.

Mamma. I am glad to hear that, my dear; because I hope it has led you also to feel more love and gratitude to that kind and gracious God who has made them to be such a means of comfort to you.

Jane. Mamma, if I was blind, I think I should do nothing but cry, I should be so miserable,—are blind people ever happy?

MAMMA. Yes, my dear; some of them very happy indeed, and particularly cheerful; and if God should be pleased to take from us the blessing of sight, it would be very sinful to murmur, because even our greatest trials he sends in love.

JANE. But, mamma, I cannot see how it can be kind to take away that which makes us happy?

MAMMA. Sometimes you cannot understand why I take away from you things which you like very much; and yet you know that I love you so dearly, that I never should do it unless it was for your good.

JANE. Yes, dear mamma, I know that, though I cannot always feel it at the time.

MAMMA. You only think of the present pleasure it gives you; but I may know more than you do, and may be able to see that it will do you harm; and so, because I love you, I give you sorrow now, in order to do you good.

JANE. Yes; I know that you never mean to be unkind to me; but you would not make me blind, mamma?

MAMMA. No dear; but God is infinitely wiser

than I am; he can read our hearts, and he sees all the sin that is in them; so, like a kind Father, he punishes us, that he may root out of us, or crush down the evil that he sees there. We spoke a little on this subject in our last Conversation; but now, I should like each of you to give me some texts where God tells us this.

Frank. I know one in Proverbs, iii. 11, 12.—"My son, despise not the chastening of the Lord, neither be weary of his correction; for whom the Lord loveth he correcteth, even as a father the son in whom he delighteth."

Emily. And there is one just like it in Hebrews, xii. 5—11.—"My son, despise not thou the chastening of the Lord, nor faint when thou art rebuked of him; for whom the Lord loveth he chasteneth, and scourgeth every son whom he receiveth. If ye endure chastening, God dealeth with you as with sons: for what son is he whom the Father chasteneth not? But if ye be without chastisement, whereof all are partakers, then are ye bastards, and not sons. Furthermore, we have had fathers of the flesh, which corrected us, and we gave them reve-

rence: shall we not much rather be in subjection unto the Father of spirits, and live? For they verily for a few days chastened us after their own pleasure; but he for our profit, that we might be partakers of his holiness. Now, no chastening for the present seemeth to be joyous, but rather grievous, nevertheless, afterward it yieldeth the peaceable fruit of righteousness, unto them which are exercised thereby."

FRANK. And I remember another in Psalm, xciv. 12.—"Blessed is the man whom thou chastenest, O Lord, and teachest him out of thy law."

MAMMA. Look, Jane, in the cxix. Psalm, and see if you cannot find a text something like those your brother and sister have given.

JANE looked, and then said, mamma, is it in the 75th verse?

MAMMA. Yes; read it.

JANE. "I know, O Lord, that thy judgments are right, and that thou in very faithfulness hast afflicted me."

FRANK. I remember a text, also on the subject, in the Lamentations. Here it is, in the 3d chapter, verses 31 to 33.—"The Lord will not cast off for ever.

But though he cause grief, yet will he have compassion according to the multitude of his mercies. For he doth not afflict willingly, nor grieve the children of men."

MAMMA. Yes; and there are many other parts of Scripture in which the Lord tells us the same thing. He continually calls himself "our Father;" and also assures us that he loves us with all the tenderness of a mother. In Isaiah lxvi. 13. he says,—"As one whom his mother comforteth, so will I comfort you."

EMILY. Oh! and there is that verse, may I find it mamma, where it is said,—"Can a woman forget her sucking child, that she should not have compassion on the son of her womb? Yea, they may forget, yet will I not forget thee." Here it is in Isaiah xlix. 15.

MAMMA. Now, dear Jane, do you see that we need not think that God, whose name is Love, can ever be unkind to us, or cease to love us, though he may think it necessary to "chasten us sore."

JANE. Yes, mamma; but I hope I shall never be blind.

MAMMA. I hope so, too, my dear child; but if

you should be so afflicted, I trust that God will give you grace to bear the trial as you ought to do. Do you remember any instance in Scripture where God took away the sight of one whom he loved for a time?

FRANK. Yes, Saul, mamma. When he was going to Damascus, he was struck blind, and continued so for three days.

MAMMA. Find the passage and read it.

FRANK. It is in Acts, ix. 8—18. "And Saul arose from the earth, and when his eyes were opened, he saw no man; but they led him by the hand, and brought him into Damascus. And he was there three days without sight, and neither did eat nor drink. And there was a certain disciple at Damascus, named Ananias, and to him said the Lord in a vision, Ananias. And he said, Behold, I am here, Lord. And the Lord said unto him, Arise, go into the street which is called Straight, and inquire in the house of Judas, for one called Saul of Tarsus; for behold he prayeth, and hath seen in a vision a man named Ananias, coming in, and putting his hand on him, that he might receive his sight.

Then Ananias answered, Lord, I have heard by many of this man, how much evil he hath done to thy saints at Jerusalem: and here he hath authority from the chief priests, to bind all that call on thy name. But the Lord said unto him, Go thy way: for he is a chosen vessel unto me, to declare my name before the Gentiles, and kings, and the children of Israel. For I will show him how great things he must suffer for my name's sake. And Ananias went his way, and entered into the house; and putting his hands on him, said, Brother Saul, the Lord, even Jesus that appeared unto thee in the way as thou camest, hath sent me, that thou mightest receive thy sight, and be filled with the Holy Ghost. And immediately there fell from his eyes, as it had been scales, and he received sight forthwith, and arose, and was baptized."

Emily. And the same account is related by Paul himself, in Acts xxii. It was the bright light which he saw that blinded him; for he says, verse 11,—"And when I could not see, for the glory of that light, being led by the hand of them that were with me, I came into Damascus."

JANE. I remember reading, the other day, in the Bible, about some one else who was struck blind.

EMILY. Oh, Jane means Elymas the Sorcerer; but that was not intended as a proof of God's love, was it mamma? It was because he had been so sinful as to resist the preaching of the truth.

MAMMA. True, Emily; let us read the passage: It is in Acts xiii. 6—11. "And when they had gone through the isle unto Paphos, they found a certain sorcerer, a false prophet, a Jew, whose name was Bar-Jesus: which was with the deputy of the country, Sergius Paulus, a prudent man; who called for Barnabas and Saul, and desired to hear the word of God. But Elymas the sorcerer, (for so is his name by interpretation), withstood them, seeking to turn away the deputy from the faith. Then Saul, (who also is called Paul) filled with the Holy Ghost, set his eyes on him, and said, O full of all subtilty and all mischief, thou child of the devil, thou enemy of all righteousness, wilt thou not cease to pervert the right ways of the Lord? And now, behold, the hand of the Lord is upon thee, and thou shalt be blind, not seeing the sun for a season. And immediately

there fell on him a mist and a darkness; and he went about seeking some to lead him by the hand."

What end did God intend to answer by that judgment?

EMILY. To convince the deputy of the truth; for it says, verse 12,—"Then the deputy, when he saw what was done, believed, being astonished at the doctrine of the Lord."

MAMMA. Sometimes God condescends to show us *why* he does particular things; but often we could not understand his reasons, and then we must be content to know that "he doeth all things well," though "his judgments are far above out of our sight;" for, "as the heavens are higher than the earth, so" he says, "My ways are higher than your ways, and my thoughts than your thoughts."

JANE. I remember, Mamma, that Christ cured some man of blindness, who could not see before in all his life.

MAMMA. You are right; let us find the place.

FRANK. It is in John ix, mamma.

MAMMA. If you read the 2d verse, you will see that even Christ's disciples wanted to find out some

particular reason why he was so affected; for "his disciples asked him, saying, Master, who did sin, this man or his parents, that he was born blind?" And mark how our Lord answered them,—"Neither hath this man sinned nor his parents, but that the works of God should be made manifest in him."

FRANK. Do you not think, that that miracle of our Lord's surprised the people more than all the rest; because they said, verse 32,—"since the world began, was it not heard that any man opened the eyes of one that was born blind."

MAMMA. I think you are right. They were very much astonished at his raising the dead. But had no one ever done this before?

EMILY. Yes: Elijah and Elisha.

MAMMA. Who did Elijah raise from the dead?

FRANK. The son of the widow of Zarephath; the account is given in 1 Kings, 17th chapter.

MAMMA. And who did Elisha raise?

EMILY. The son of the Shunammite.

MAMMA. Yes; find the history of it.

EMILY. I have found it in 2 Kings, 4th chapter.

MAMMA. And was there not another miracle of a similar, kind wrought about the same time?

FRANK. I know what you mean; it was after Elisha's death, was it not?

MAMMA. Yes; look for it.

FFRAN. Here it is, in 2 Kings, xiii. 20, 21.—"And Elisha died, and they buried him: And the bands of the Moabites invaded the land at the coming in of the year. And it came to pass as they were burying a man, that behold, they spied a band of men, and they cast the man into the sepulchre of Elisha: and when the man was let down and touched the bones of Elisha, he revived, and stood up on his feet."

MAMMA. Do you remember another instance, besides that recorded in John ix, of our Lord healing the eyes of the blind?

FRANK. Yes; but I do not know exactly where it is.

MAMMA. Look in the Gospel of St. Mark till you find it.

EMILY. I have found it, mamma; it is in the 8th chapter,—may I read it?

MAMMA. Yes, dear.

EMILY read Mark viii. 22—25. "And he cometh to Bethsaida, and they bring a blind man to him, and besought him to touch him. And he took the blind man by the hand, and led him out of the town; and when he had spit on his eyes, and put his hands upon him, he asked him if he saw ought. And he looked up, and said, I see men as trees, walking. After that, he put his hands again upon his eyes, and made him look up, and he was restored, and saw every man clearly."

JANE. Mamma, was there not a king who had his eyes put out, that we read of in the Bible?

MAMMA. Yes; who was he?

EMILY. Zedekiah; but it was not God who did that.

MAMMA. No; but it was a punishment which God permitted to fall upon him because of his sins. Let us read the account, for it is a very instructive one. He had been warned and taught by God's prophets, and he would not listen to their threatenings; so at last God permitted all the evil to come upon him, which he had declared he would do, un-

less he turned and repented. Read what is written in the 36th chapter of the Second of Chronicles, from the 11th to the 21st verse.

FRANK. "Zedekiah was one-and-twenty years old when he began to reign, and reigned eleven years in Jerusalem. And he did that which was evil in the sight of the Lord his God, and humbled not himself before Jeremiah the prophet, speaking from the mouth of the Lord. And he also rebelled against king Nebuchadnezzar, who had made him swear by God: but he stiffened his neck, and hardened his heart from turning unto the Lord God of Israel. Moreover, all the chief of the priests, and the people transgressed very much, after all the abominations of the heathen, and polluted the house of the Lord which he hallowed in Jerusalem. And the Lord God of their fathers sent to them by his messengers, rising up betimes and sending; because he had compassion on his people, and on his dwelling-place: But they mocked the messengers of God, and despised his words, and misused his prophets, until the wrath of the Lord arose against his people, till there was no remedy. Therefore he brought upon them

the king of the Chaldees, who slew their young men with the sword, in the house of their sanctuary, and had no compassion upon young man, or maiden, old man, or him that stooped for age: he gave them all into his hand. And all the vessels of the house of God, great and small, and the treasures of the house of the Lord, and the treasures of the king, and of his princes: and all these he brought to Babylon. And they burnt the house of God, and brake down the wall of Jerusalem, and burnt all the palaces thereof with fire, and destroyed all the goodly vessels thereof. And them that had escaped from the sword, carried he away into Babylon: where they were servants to him and his sons, until the reign of the kingdom of Persia: To fulfil the word of the Lord by the mouth of Jeremiah, until the land had enjoyed her sabbaths: for as long as she lay desolate, she kept sabbath, to fulfil three score and ten years."

FRANK. But it does not say there that they put out Zedekiah's eyes; I think it must be mentioned in the Book of Kings, for I sure I remember it. Yes; here it is in 2 Kings, xxv. 7.—"And they slew the sons of Zedekiah before his eyes, and they

put out the eyes of Zedekiah, and bound him with fetters of brass, and carried him to Babylon."

MAMMA. When we were speaking of Christ's restoring sight to the blind, I meant to have asked you whether you recollected any prophecies in the Old Testament which declared that he should do so?

FRANK. I think there are some in Isaiah. I should like to find them,—may I?

MAMMA. Yes, do so.

FRANK. Here is one, mamma, in the 35th chapter, the 5th and 6th verses.—"Then the eyes of the blind shall be opened, and the ears of the deaf shall be unstopped. Then shall the lame man leap as an hart, and the tongue of the dumb shall sing: for in the wilderness shall waters break out, and streams in the desert."

MAMMA. Yes; that refers to Christ's coming.

EMILY. I have found a text, too, in Isaiah, xlii. 6, 7.—"I the Lord have called thee in righteousness, and will hold thine hand, and will keep thee, and give thee for a covenant of the people, for a light of the Gentiles; to open the blind eyes, to

bring out the prisoners from the prison, and them that sit in darkness out of the prison-house."

MAMMA. You must not suppose that these texts refer merely to the miraculous powers which our Lord possessed, and which he employed in opening the eyes of those who were naturally blind; it means something more than that,—what do you think it is?

FRANK. I suppose it means that he gives light to our minds.

MAMMA. Yes; we are all by nature in a state of darkness; that is, we do not see, and cannot love things which are spiritual and holy,—things which concern God and heaven. The prophet Isaiah, speaking of the state of the earth when Christ came, says,—"The people that walked in darkness have seen a great light, and they that dwell in the land of the shadow of death, upon them hath the light shined." Isa. ix. 2. And again, "Arise, shine, for thy light is come, and the glory of the Lord is risen upon thee. For, behold, darkness shall cover the earth, and gross darkness the people; but the Lord shall arise upon thee, and his glory shall be seen

upon thee." Isa. lx. 1, 2. You will find another passage like this in the 42nd of Isaiah.

FRANK. Let me try and find it. Is it in the 6th and 7th verses?

MAMMA. Yes.

FRANK. "I, the Lord have called thee in righteousness, and will hold thine hand, and will keep thee, and give thee for a covenant of the people, for a light of the Gentiles; to open the blind eyes; to bring out the prisoners from the prison; and them that sit in darkness out of the prison-house."

EMILY. Tell me where to look for another verse, will you, mamma?

MAMMA. In the 49th chapter.

EMILY. Here it is, in the 6th verse:—"And he said, It is a light thing that thou shouldest be my servant to raise up the tribes of Jacob, and to restore the preserved of Israel: I will also give thee for a light to the Gentiles, that thou mayest be my salvation unto the ends of the earth."

JANE. Do, mamma, tell me also where to look?

MAMMA. From whence is it Jane, that light comes to us?

JANE. From the sun.

MAMMA. Yes; then look in the last chapter of the last book in the Old Testament, and see what Christ is there called.

JANE. You mean, Malachi, mamma. In the second verse of that chapter it says,—"Unto you that fear my name, shall the Sun of Righteousness arise with healing in his wings."

MAMMA. Now can you tell me of any passages in the New Testament, where Christ is spoken of in like manner?

FRANK. Yes, mamma, I know of one; it is the same which we read in Isaiah; it was what Simeon said when he took Christ into his arms, "A light to lighten the Gentiles, and the glory of thy people Israel." Luke ii. 32.

MAMMA. If you look, Jane, at Matthew iv., you will see the text which we read in Isaiah ix. 2, applied to Christ.

JANE read. "The people which walked in darkness saw great light, and to them which sat in the region and shadow of death, light is sprung up."

FRANK. Mamma, I remember a passage that

you explained to us not long ago, on this subject, in the first chapter of St. John's Gospel, verses 4—9. "In him was life, and the life was the light of men; and the light shineth in darkness; and the darkness comprehended it not. There was a man sent from God, whose name was John, the same came for a witness, to bear witness of that light, that all men through him might believe. He was not that light, but was sent to bear witness of that light. That was the true light, which lighteth every man that cometh into the world."

Emily. Yes; and in the account of the man that was born blind, Christ says,—"As long as I am in the world, I am the Light of the world." John ix. 5.

Mamma. In the eighth chapter, he also uses similar terms.

Frank. Let me try and find where. I think it must be in the twelfth verse:—"Then spake Jesus again unto them, saying, I am the light of the world; he that followeth me shall not walk in darkness, but shall have the light of life."

Emily. And in the twelfth chapter, verse 35,

there is something very like that:—" Then Jesus said unto them, yet a little while is the light with you: walk while ye have the light, lest darkness come upon you: for he that walketh in darkness, knoweth not whither he goeth. While ye have the light, believe in the light, that ye may be children of light." And in verse 46, Christ says,—" I am come a light into the world, that whosoever believeth on me should not abide in darkness."

MAMMA. Yes; and let me point out to you some verses which you have passed over; they are in the latter part of the 9th chapter.

FRANK. May I read them, mamma?

MAMMA. Yes, dear; from verse 39th to the end.

FRANK read,—" For judgment am I come into this world: that they that see not might see; and that they that see might be made blind. And some of the Pharisees which were with him, heard these words, and said unto him, are we also blind? Jesus said unto them, if ye were blind, ye should have no sin: but now ye say, we see; therefore your sin remaineth."

MAMMA. By the answer the Pharisees gave, we find that they were quite ignorant of their own state; they fancied themselves to be very wise and good, though our Lord, who read their hearts, thought them both blind and wicked. So does each one of us deceive ourselves, till Christ, who is "the true light," shines within us, and then we find that we were before only dark and evil. Satan, our great enemy, is called "the Prince of Darkness," because he likes to keep us from knowing our real condition.

FRANK. I think there is a text, where he is said to make people blind,—where is it, mamma?

MAMMA. You will find it in the 2nd Epistle to the Corinthians, 4th chapter, verses 3, 4, and 6.

FRANK. Oh, yes.—"But if the Gospel be hid, it is hid to them that are lost: in whom the God of this world hath blinded the minds of them which believe not, lest the light of the glorious Gospel of Christ, who is the image of God, should shine into them. For God, who commanded the light to shine out of darkness, hath shined in our hearts, to give the light

of the knowledge of the glory of God, in the face of Jesus Christ."

MAMMA. Thus, you see, that it is not enough for the light to shine upon our eyes, it must shine into our hearts; and unless it does so, all our knowledge of Christ and his Word will do us no good. A blind man lives in a world full of light; but he is not at all the better for it, because it only shines upon him, it does not shine into him.

FRANK. But how can we know whether the light only shines *upon* us, or shines *into* us? And how can we tell the difference between believing a thing with our heads and with our hearts?

MAMMA. Your question is a very important one, and I will try to give you a plain answer to it. Do you not think that there is a wide difference between knowing a great deal about a person's history, so that you could mention every particular of it, and loving that person very much?

FRANK. Yes, certainly, mamma.

MAMMA. And is there not a still wider difference between esteeming a person, because he is a wise and

good man, and loving him, because he is your own dear friend, and has spent his life in doing you every sort of kindness?

FRANK. O, yes, mamma.

MAMMA. This, then, is just the difference between having light around us, and light within us,—that is, between knowing about Christ and really being a Christian. We cannot love him till we know about him; but many persons *know* a great deal about him and *do not love* him. I wish you always to remember the distinction; and I pray God daily to put his love into your heart. There are many ways in which this truth is taught us in the Scriptures. In 1 Peter ii. 3, it is called, "tasting that the Lord is gracious;" and do you not remember a verse in the Psalms like that?

EMILY. O, yes; I think it is in the 34th. "O taste and see that the Lord is good: blessed is the man that trusteth in him.

MAMMA. Sometimes Christ calls himself bread, and then he says, "He that eateth of me shall live for ever." Where is that?

FRANK. I think I know: Yes; it is in John 6th.

MAMMA. You are right; read me the passage from the 32d to the 35th verse.

FRANK read.—"Jesus said unto them, Verily, verily, Moses gave you not that bread from heaven, but my Father giveth you the true bread from heaven; for the bread of God is he which cometh down from heaven, and giveth life unto the world. Then said they unto him, Lord, evermore give us this bread. And Jesus said unto them, I am the bread of life; he that cometh to me shall never hunger, and he that believeth on me shall never thirst.

MAMMA. Now, Emily, read from verse 48 to 58.

EMILY read.—"I am that bread of life. Your fathers did eat manna in the wilderness, and are dead. This is that bread which cometh down from heaven, that a man may eat thereof and not die. I am the living bread which came down from heaven; if any man eat of this bread he shall live for ever; and the bread that I will give is my flesh, which I will give for the life of the world. The Jews therefore strove amongst themselves, saying, How can this man give his flesh to eat? Then Jesus said unto them, Verily, verily, I say unto you, except ye eat the flesh of the

Son of Man, and drink his blood, ye have no life in you. Whoso eateth my flesh and drinketh my blood, hath eternal life, and I will raise him up at the last day; for my flesh is meat indeed, and my blood is drink indeed. He that eateth my flesh and drinketh my blood dwelleth in me, and I in him. As the living Father hath sent me, and I live by the Father, so he that eateth me, even he shall live by me. This is that bread which came down from heaven; not as your fathers did eat manna, and are dead: he that eateth of this bread shall live for ever."

Mamma. You know that if we were very hungry, and the most nourishing food was put before us; if we only looked at it, or took it into our hands it would give us no support; so if we only hear about Christ, and do not ourselves feed upon him, we shall, as he told the Jews would be their sad case, die in our sins. We must therefore constantly beg him to give us his Holy Spirit, that we may not only know what is his will, but believe with our hearts unto righteousness; and He has promised that he will give this good gift to them that ask him.

Conversation VI.

SHORT ACCOUNTS OF CELEBRATED BLIND PERSONS.

Emily. Have any blind persons ever been distinguished, mamma, notwithstanding their loss of sight?

Mamma. Yes, a great many; and some of them have excelled in those arts and sciences, which seemed to require the full possession of every faculty. Now what would you think they might easily attain?

Frank. Whatever could be learned by feeling, or from hearing books read to them, or by the ear, such as music or singing.

Mamma. What will you think when I tell you of some men, who have learned the most difficult sciences, as mathematics for instance; and not only so, but have given public lectures, and instructed others in these subjects?

FRANK. O, mamma, how could that be,—do tell us more about it?

MAMMA. I will give you a short account of some of those who, by the efforts of their own genius, have not only borne up against this heavy trial of blindness, but have been able to do wonders notwithstanding.

FRANK. I think, mamma, that we shall hear not only of some in our own days, but also of those in former days; because Homer was blind, and yet he wrote such beautiful poetry.

EMILY. Yes; but it is not so difficult to suppose that a person might write poetry, as do many of the other things which mamma spoke of. He would not want sight for that; because he could dictate his thoughts to another person, who could write them down for him.

FRANK. But sister, if he had not seen the things he describes, how could he have written about them?

EMILY. True, Frank; but was he always blind?

MAMMA. No; and from the great distance of time at which he lived, very little on which we can depend is preserved of his history. It is generally thought that he wrote the Iliad and Odyssey after he lost his

sight; but he evidently retained a strong impression of the scenes with which he had been previously familiar.

FRANK. I think he must have been a soldier, or he could never have written such accounts of battles as he does, and perhaps he lost his eyes in fighting for his country.

MAMMA. Your supposition is as well-founded as most which are made, as to his early life; and his extreme poverty may give some colour of truth to it; for he is said to have begged his bread through the cities of Greece.

FRANK. O, yes, mamma; those ungrateful Greeks always either neglected or punished the men who had suffered for them.

MAMMA. That is too true; and with their usual versatility, no sooner was Homer dead, than seven of the principal towns contested for the honour of having been his birth-place. There are several other celebrated persons of antiquity who were deprived of the power of seeing. The tutor of the great Roman orator, Cicero, was one of these. His name was Diodotus the Stoic, and he continued to study himself, and

to teach others both philosophy and geometry, notwithstanding his blindness.

EMILY. I suppose, as he was a Stoic, he did not choose any body to know that he minded it.

MAMMA. That is not improbable; but his acquirements in knowledge were not so wonderful as those of men who had never enjoyed the blessing of sight.

Another celebrated man, named Didymus of Alexandria, who was a Christian writer in the fourth century, was not ashamed to reply, when frequently asked by St. Anthony, who came to visit him, whether he felt grieved that he was blind, that he certainly did, which greatly surprised the Saint, who said, that he wondered that he should care so much for a faculty, which he only had in common with gnats and ants.

JANE. How very wrong to speak so of one of God's best gifts,—was it not, mamma?

MAMMA. Yes; and I do not think he would have been particularly pleased, if the same calamity had befallen himself. There is no real virtue in despising those things which a gracious God bestows upon

us, though this mistaken Saint fancied that there was.

JANE. And who else was there, mamma?

MAMMA. In the year 1513, Franciscus Salinas was born at Burgos in Spain. He lost his sight in infancy, but became not only an excellent musician, but a very fine composer, and he obtained, from his knowledge and skill, the Professorship of Music in the University of Salamanca.

Caspar Crumbhorn flourished about the same time in Germany, and equally excelled as a musician.

EMILY. I remember a remarkable man in our own country, who was blind,—I mean Milton,—does not he often allude to it in his poems?

MAMMA. Yes he does; and evidently with a deep sense of his loss.

FRANK. He was too good to pretend that he did not care about it.

MAMMA. Yes; and we have most clear and satisfactory proofs from the manner in which he refers to it himself, that he looked upon this affliction as a visitation from God, which he desired to improve to his soul's good and his Father's glory.

FRANK. Do, mamma, repeat to us once more that beautiful sonnet on his blindness, which you are so fond of.

MAMMA. I will, my dear.

" When I consider how my light is spent,
Ere half my days, in this dark world, and wide,
And that one talent, which is death to hide,
Lodg'd with me useless; though my soul more bent
To serve therewith my Maker, and present
My true account, lest he returning chide:
Doth God exact day-labour, light denied,
I fondly ask? But patience to prevent
That murmur, soon replies, God doth not need
Either man's work, or His own gifts: who best
Bear his mild yoke, they serve him best; His state
Is kingly, thousands at his bidding, speed,
And post o'er land and ocean without rest;
They also serve, who only stand and wait."

Here is true Christian submission to God's will. Milton expresses the same, also, when he says,—after describing most pathetically all the happiness from which he is cut off,—

" So much the rather, thou Celestial Light,
Shine inward, and the mind thro' all her powers
Irradiate: There plant eyes; and mist from thence
Purge and disperse, that I may see and tell,
Of things invisible to mortal sight."*

* Paradise Lost, Book III.

EMILY. Does he not mean Christ, when he addresses Celestial Light, and asks it to shine into his soul, that all inward darkness may be driven away, and that he may learn things spiritual?

MAMMA. He does; and how exactly those lines are in accordance with the Word of God!

FRANK. And just like the Collect, too, "Lighten our darkness, we beseech thee, O Lord."

EMILY. How did Milton manage to go on studying, mamma; because he wrote Latin as well as English?

MAMMA. His daughters used to read to him both Latin and Greek, and to write from his dictation. One of our poets has given a beautiful description of the cause of Milton's blindness, which he attributes to his having gazed upon glories too splendid for mortal eyes to behold, and adds,—

> "He saw, but blasted with excess of light,
> "Closed his eyes in endless night."

Milton was born about the year 1612, and flourished during the reigns of Charles the First, the Protectorate of Oliver Cromwell, and the reign of Charles the Second.

EMILY. You have told us of blind poets and musicians, mamma, but I suppose that in the other arts, such as sculpture and painting, no one could ever excel who had not the full use of his sight?

MAMMA. I should think that a blind man could not be a painter; but there are instances on record of sculptors who suffered from this calamity, and yet succeeded in producing fine statues.

FRANK. I suppose it must have been by the sense of touch, which becomes much more acute, from the loss of the other powers.

MAMMA. Certainly; for some of them have been enabled to take the model of a face, simply by the touch. They first made a cast in wax, and then made a bust from it. One of these blind sculptors took an exact likeness of the Duke de Bracciano, and also made a marble statue of Charles the First.

EMILY. Do you think, mamma, that the other faculties, as well as touch, are more vigorous in the blind?

MAMMA. Yes; and a remarkable proof of this is afforded by the fact, that some blind persons have been able to discover the height of individuals from

the sound of their voices, and to know at once, on entering a room, how many strangers were present, and where they were seated.

JANE. How very odd. I should like to see some of these clever persons.

MAMMA. You will think it still more odd, Jane, when I tell you of a poor man, who is only lately dead, called John Metcalf, whose occupation in early life was that of a wagoner, and a guide.

JANE. A *guide*, mamma?

MAMMA. Yes; and that in the most intricate roads during the night, or when the track was lost because of a deep fall of snow.

JANE. And is that certainly true?

MAMMA. Yes; the account is authenticated by many eye witnesses. But this is not all he did; he used to be employed to plan high-roads, that is, to find out how they could be cut, over difficult, dangerous, and mountainous tracts of country.

EMILY. Then he had always some one with him, I suppose, to help him?

MAMMA. On the contrary, he preferred being alone, and his biographer says, that he has often

met him, "with only his long staff, traversing the roads, ascending precipices, exploring valleys, and investigating their several extents, forms, and situations." Most of the roads about the Peak in Derbyshire, have been altered by his directions.

EMILY. This account really surpasses all I could have conceived possible.

MAMMA. But it is as mathematicians that the blind have been particularly distinguished, and they have excelled in the most abstruse of the sciences. One of these was Leonard Euler; he was born at Basil in 1707, and studied with such diligence, that he obtained high honours in several of the universities on the Continent. He was invited to Petersburg by the Empress Catharine, where a most difficult mathematical problem was proposed by the university, which, it was expected, could not be solved in less than several months. Euler, however, accomplished it in less than three days; but the intense application which he had been obliged to use, threw him into a violent fever, which nearly cost him his life, and deprived him of the sight of one of his eyes.

JANE. O, he was not blind, then, before that, mamma?

MAMMA. No; but after that he continued his labours, and at last, in the 59th year of his age, he became totally blind.

EMILY. I wonder, when he had lost one eye through over-exertion, he did not take care of the other.

MAMMA. His intense love of learning urged him on, and some of the most extraordinary works which he composed were written after this period. He dictated them to a young man, who, though quite ignorant when he first employed him, is said to have acquired great knowledge from the clearness and simplicity of Euler's mode of expressing himself. He had to pass through severe trials, which he bore with much firmness and magnanimity. Once his house was burnt down, and he narrowly escaped with his life. But the greatest affliction was yet to come. It was thought that if he had an operation called couching performed upon his eyes, he would recover his sight entirely, and so it proved; but either through the carelessness of the

surgeon, or because he used them before they were sufficiently strong to bear the effort, he soon became totally blind again, and so continued during the rest of his life.

EMILY. I think that was almost worse than his first blindness, it must have been such a dreadful disappointment to him.

MAMMA. Yes, it was indeed; and from that time his eyes caused him intense suffering; but he bore it with remarkable cheerfulness and patience.

FRANK. Did he excel in anything besides the mathematics, mamma?

MAMMA. Yes; in medicine, chemistry, botany, and in the sciences of music and astronomy. One of his most distinguished works, written during his blindness, was on the latter subject. He obtained a great many prizes from different universities; and the number of works which he published is quite astonishing. Only the catalogue of them exceeds fifty printed pages. Amongst these are twenty-nine volumes quarto, and two octavo in Latin; one volume quarto, and six octavo in German; and five volumes octavo in French. He composed several other works

not named in this catalogue, and left, at his death, about a hundred memoirs ready for publication, which are not yet all printed.

FRANK. It seems almost incredible that one man could have accomplished so much,—did he live to a very great age?

MAMMA. He was about 71 at the time of his death; and the wonder is so much the greater, if you reflect, that some of these works were on subjects which required the deepest thought and reflection, and which no ordinary man could have accomplished. It is said that he was an affectionate father and husband, and universally beloved. What a noble example Euler sets us, to encourage to diligence and perseverance, whatever difficulties may oppose themselves.

FRANK. He does, indeed, mamma; but everybody could not do what Euler accomplished.

MAMMA. No, certainly; for he had such a powerful and vigorous genius as few men possess; but if his industry had not been equal to his talents, he would have made no more of them than many very

clever men do, who are mere cumberers of the ground.

JANE. Euler was certainly a very great man, mamma; but as he did not become blind till 59, it was not so extraordinary as if he had been so all his life.

MAMMA. Well, then, I will tell you about another person, whose name was Nicholas Saunderson, who, I hope, will satisfy you. He was born at Thurston, in Yorkshire, in 1682, and lost his sight by small pox, before he was a year old.

JANE. Well, mamma, if he was very learned it *is* remarkable; for he could not have acquired anything before that time.

MAMMA. He was sent to a grammar-school, where he soon got beyond the other boys, in Latin and Greek.

EMILY. How did he learn those languages?

MAMMA. No account, unfortunately, is preserved of the manner in which he acquired them; but there can be no doubt that others must have read to him, till by the strength of his memory he retained what he heard. This he did to such a degree, that

he learned to converse in Latin with the utmost facility, and to dictate compositions in it to others. When he left school his father taught him arithmetic, and a gentleman who pitied him much, instructed him in geometry; but he soon knew so much more than they could teach him, that he used to get some one to read to him, and so taught himself.

FRANK. And how did he get on after that, mamma?

MAMMA. He was sent to Cambridge, in order to give lectures there on mathematics, and on other subjects; and the general feeling of pity that was excited by his blindness, and of admiration for his great talents, raised him up many powerful and generous friends. What caused peculiar wonder was, that he chose subjects for his lectures, which it seemed impossible for a blind man, either to illustrate or to understand.

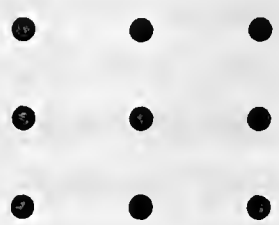
EMILY. What subjects, mamma?

MAMMA. Those of light and of colour, of which I cannot now give you a full explanation; because, before you can understand them, you must be ac-

quainted with at least the elementary part of natural philosophy. When you are older, you shall read an account of the way in which Saunderson taught mathematics.

Frank. And did he teach arithmetic, too? He certainly could not do so by a slate.

Mamma. No; he adopted a plan for this purpose, not unlike in principle to your arithmetical frame, though it differed in this respect, that instead of being made of wires with balls strung on them, it consisted of a board full of holes. These holes were made in sets of nine thus:—



In each of the holes he stuck a pin, and in the middle one a pin with a large head; and when he wanted a tenth mark, he stuck two large headed pins together in one hole. By this simple machine he could work the most difficult sums; and move his pins from place to place in making his calculations with incredible swiftness.

Jane. How did he know where the pins stood?

Mamma. By placing his finger over the top of them, he could in an instant tell the whole state of

the sum, and even lay it aside and resume it, without the least difficulty, in the same manner.

EMILY. What a clear head he must have had.

MAMMA. Yes, he had indeed; for he could make the most difficult calculations mentally, even without the aid of this machine.

FRANK. Did he obtain many pupils at Cambridge?

MAMMA. Yes; he taught so admirably, that numbers came to be instructed by him; and Sir Isaac Newton sought his friendship, and by means of this great man, he was at length raised to high honors at the university.

JANE. From what you have told us, I think that Saunderson's sense of touch must have been very acute.

MAMMA. It was; and not only in the fingers, but this power seemed to be generalty diffused over his frame; for he could tell when any thing was held near his face, or when he went by a tree, or when a cloud was passing over the sun; and when he entered a room, he could discover its size, and the dis-

tance at which he stood from each of the walls in the same way.

EMILY. I think he would hardly have been happier if he could have seen; for he was able to do almost every thing better without sight, than most people can do with it. Did he live to a great age, as well as Euler?

MAMMA. No; he was only 57 when he died.

JANE. Then he got through all his labours before he was so old as Euler was when he lost his sight?

EMILY. Yes; because he could see with one eye till he was 59.

JANE. I do think Saunderson was the most extraordinary of the two,—don't you, mamma?

MAMMA. I think he was, Jane; and I am glad you are satisfied at last.

JANE. Now, mamma, pray tell us some more stories about these blind people; I shall never be tired of hearing them.

MAMMA. But I am afraid I shall be tired of telling them, if I go on longer now, so we will talk again about it another time. In the meanwhile,

what is the best improvement we can make of what we have heard?

EMILY. To be very thankful for the blessing of sight, and to make the best use we can of it.

MAMMA. And I think, too, to use great industry and application in learning everything we can, whilst we have the mercy; so that if it should please God to take it from us, we might have got a great store by us, for the dark season that will follow.

JANE. Like the ants, who put by their food in the summer for the cold weather.

MAMMA. And Jane, I hope, will never complain again of the trouble of learning music; because that is one of the greatest comforts the blind can have, and is an endless source of amusement to them. I knew a blind lady who continually lamented that she could not play on the pianoforte.

JANE. Well, mamma, I really will be more diligent; but is there any fear of my losing my sight?

MAMMA. We can never tell what may happen to us; and though this is a less frequent occurrence to young persons, since the small pox has in a great

degree been driven out of our country; yet it is not unusual after violent fevers, or other complaints, for this calamity to befal even those who have been before healthy and strong. To-morrow, if we have a little spare time, I will tell you more about the blind.

Conversation VII.

THE SAME SUBJECT CONTINUED.

Frank. Now, mamma, are you disengaged, and can you spare a little more time to talk to us about the blind?

Mamma. Yes; but I do not think that I can tell you of any persons quite so remarkable as those whose histories you heard yesterday. There is one, however, of the name of Moyes, who was much distinguished. He lost his sight by smallpox, when only three years old; notwithstanding which, like Saunderson, when quite a boy, he made great progress in his studies.

Jane. Do you suppose, mamma, that he could recollect anything that he saw before he was three years old? I think I can.

MAMMA. Yes; there is every reason to believe that he did. He used to say that he distinctly remembered having noticed the working of a wheel in a water-mill, which was constructed in a particular manner; and after he became blind, he used to make little models of mills, most probably in consequence of this early impression.

FRANK. But, mamma, how could he do that; because he could not make mills without tools, and he might have hurt himself if he used them?

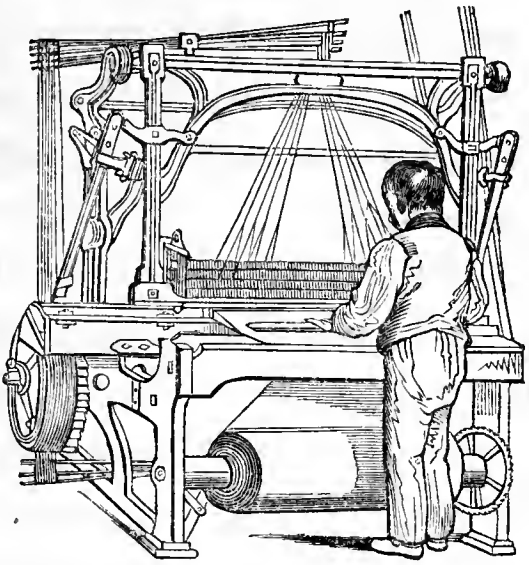
MAMMA. He got accustomed to employ them, and though he cut himself a little at first, he soon became so skilful, as to be able to work without danger, and he even made a loom with his own hands.

JANE. What is a loom, mamma?

MAMMA. It is a machine used for the manufacture of several kinds of goods. Silk, calico, linen, net, ribbons, and various other articles, are made in this manner, though the construction of the loom differs, according to the purpose it is designed to answer.

JANE. Do, mamma, describe one to us.

MAMMA. I will take you to see one at work; for you would get but a very confused notion of it from any description which I could give; and in the meantime I will show you a picture of one.



FRANK. Thank, you, mamma.

MAMMA. Moyes pursued the same studies as Saunderson, and became acquainted with those sciences, which seem quite out of the reach of the blind. He was particularly fond of mathematics, astronomy, chemistry, and all the other studies connected with natural philosophy.

FRANK. And did he learn Latin and Greek, too?

MAMMA. Yes; he made himself perfect master of the ancient languages, and in order both to learn and to teach mathematics and geometry, he invented a plan of calculating, much more simple than that of Saunderson.

EMILY. And did he give lessons also?

MAMMA. Yes; for some time he was very poor, and he travelled about in order to give lectures on all those branches of science to which he had paid peculiar attention. One of his favourite subjects was chemistry.

FRANK. Chemistry, mamma? But surely he did not make all those curious experiments, which we saw in the lectures which we attended?

MAMMA. Yes; and he made all of them himself, with peculiar dexterity.

JANE. Then I dare say his other senses were very acute, were they not, mamma?

MAMMA. Yes; he is said to have distinguished colours readily by the touch, and to have been able to judge of the height of a person by the sound of his voice; and also by the same means, readily to discover in society, both the individuals present, and where they were seated. He received the title of Doctor out of respect to his learning.

JANE. Was he a doctor, mamma?

MAMMA. No, my dear; this title does not mean that a person is acquainted with the science of

medicine. There are Doctors of Divinity and Doctors of Laws, as well as Doctors of Medicine.

JANE. What do you mean by a Doctor, then, mamma?

MAMMA. The word comes from the Latin *doceo* to teach, *doctus*, taught. A doctor, then, means one who is taught or learned.

FRANK. How do persons get this title, mamma?

MAMMA. The regular way of obtaining it is by studying at a university; and it is bestowed upon those who have passed through a certain course of study, and have taken other degrees. It is also given to some who have not done so, either as a mark of respect to their character or services, or as a compliment on the ground of their having distinguished themselves in any way.

EMILY. And in which way did Moyes become a doctor?

MAMMA. One of the colleges in America gave him the title on account of the valuable lectures he delivered there. Another blind person obtained the degree of Doctor of Divinity by study. His name was Dr. Blacklock.

JANE. And was he blind all his life?

MAMMA. Nearly so; being only six months old when the dreadful malady, which deprived Moyes of sight, left him in the same helpless condition.

JANE. But I hope Dr. Blacklock was rich, and was not exposed to the same difficulties that Moyes was?

MAMMA. On the contrary, his father was a poor labourer, with a large family.

JANE. Then how did Dr. Blacklock manage to learn?

MAMMA. In Scotland, where he was born, in the year 1721, much more attention is generally paid, than in England, to the education of the children of the poor; and he was sent to a school, where he made great progress, both in Latin and in other studies. His father, also, was devoted in his attention to him, and he spent all his leisure time in reading and talking to his blind child. Amongst other things, he used to read a great deal of poetry to him, and as he had much taste for it, he soon began to compose himself.

JANE. I dare say he got on in the same way as

the other blind boys, by getting his school-fellows to read to him.

MAMMA. He did; but early in life he had a very severe trial. What should you think would be the greatest that could have befallen him?

JANE. The death of his kind father. I hope it was not that?

MAMMA. It was, indeed. He lost him before he was twenty. But God, who is "the Father of the fatherless," "in his holy habitation," took care of this poor boy. Do you not remember one beautiful promise in the Psalms, which says that God will do so?

EMILY. "When thy father and thy mother forsake thee, then the Lord will take thee up."

MAMMA. Yes, that is it; and we constantly see its fulfilment in the gracious manner in which God inclines the hearts of his people to care for those who are in circumstances of destitution.

FRANK. How was Blacklock provided for, mamma?

MAMMA. Dr. Stephenson, a Professor at the University of Edinburgh, sent for him, and assisted him

there to go on with all his studies. He became more generally known, by publishing a volume of poems, and when he had finished his studies, he became a clergyman.

Emily. Well, I think a blind man might make a very good clergyman, don't you, mamma; because he could study by having some one to read to him, and he need not write his sermons; and then he could go and talk to his parishioners, and teach them as well as if he could see. Did not the people love him very much? I am sure I should have done so, and it would have been so pleasant to help him, and lead him about.

Mamma. I am sorry to say, my dear, that it was quite the contrary; for the inhabitants of Kirkcudbright were so angry at his appointment, that he was soon forced to leave it.

Frank. O, how very unkind! They did not deserve to have any one to preach to them. And did he go to some other parish?

Mamma. No; he was so discouraged by the treatment he had received, that he gave up preaching, and opened a school.

FRANK. Mamma, did you ever see a blind clergyman?

MAMMA. Yes; I know one so afflicted.

FRANK. And I hope he is not treated like poor Dr. Blacklock?

MAMMA. No, he is not; and I hope such conduct would not often be met with. We should always remember in our treatment of others, to act as we should wish them to do to us. And no one knows how soon he may be dependent for comfort on the kindness of his fellow-creatures.

There was another celebrated blind writer early in the seventeenth century, whom I have not named to you. He was also a great mathematician, but he directed his studies particularly to one branch of science.

FRANK. What was that, mamma?

MAMMA. To fortification.

EMILY. What was his name?

MAMMA. The Count de Pagan.

JANE. Then he was not always blind, was he, or he could not have understood that?

MAMMA. No; he lost one eye in battle, for he was

a soldier, and then afterwards his other eye in a severe illness, which he had when he was 38.

FRANK. Then, did he write most before or after he was blind?

MAMMA. After that period. He wrote one book, which was very remarkable as the production of a blind man,—an account of the river Amazons, in which there is a plan of it, drawn by himself.

FRANK. Now you have told us of blind poets, musicians, sculptors, and mathematicians.

EMILY. And you forget John Metcalf, who planned roads.

JANE. And Count de Pagan who taught fortification, and Dr. Blacklock who preached.

FRANK. O, yes; now I wonder whether there is any one else, who studied something different from all the others.

MAMMA. Yes; I recollect one, who was a natural historian, and who wrote a very curious work on the habits and manners of bees.

FRANK. But how could he know anything about them if he could not see?

MAMMA. He had a most kind and affectionate

wife, who helped him in all his studies, and made him so happy, by entirely devoting herself to promote his comfort in every way, that he used to say, that he preferred his blindness to the possession of sight. A member of the same family wrote a most interesting work on the habits and manners of ants.

FRANK. Do tell us something about it, mamma! May we read both these books?

MAMMA. Yes, you may. Huber declares, that he only describes what he witnessed himself; but some parts of his narrative are so singular, that one can hardly help thinking, that his imagination came in a little to his aid. He thought that he discovered a kind of language, by which the ants communicated their ideas to each other, which he calls the Antenna Language, because their conversations were carried on by touching each other with the tip end of the antenna.

EMILY. O, how very odd!

MAMMA. He likewise describes their modes of warfare, plans of encampment, and skirmishing; but as this is not the book written by our blind friend, I had better keep to the subject on which we are now

speaking. All the instances which I have given you prove, that though blindness is a great calamity, yet it is not an insuperable barrier either to happiness or to usefulness.

FRANK. It is a great comfort to know, that the heaviest of all trials can be so made up to a person, as to make him almost better off than he was before.

MAMMA. It is indeed.

JANE. But many who lose their sight are not clever, like those you have told us of. Can *these* find any way of employing their time?

MAMMA. Yes; there are various simple occupations, which do not require any genius, which they can learn, and there are institutions in several parts of this country for the purpose of teaching the poorer class of them different trades, by which they can earn their livelihood.

EMILY. What trades, mamma?

MAMMA. One of the principal of these is basket-making; and it is very interesting to see with what rapidity they can do this work.

JANE. Have you ever seen them at work, mamma?

MAMMA. Yes, frequently; the men are generally employed in the coarser branches of the business, such as in making large hampers and market-baskets, and those things which require strength; and the women are taught the finer kinds of work. The work-basket which you constantly see me use, and those delicate little baskets for flowers, were bought at the Blind Asylum.

JANE. I should hardly have thought it possible that they could have made such things.

MAMMA. Another of their occupations is knitting, which they perform with the greatest rapidity, and the most beautiful gloves and purses are frequently the work of the blind.

EMILY. I think that they should always be taught music, it must be such a great pleasure to them to be able to play and sing.

MAMMA. This is generally done at public institutions for the blind, and it is indeed delightful to hear their voices in evening worship, lifted up together in praise of Him who is the light, and can shine in-

wardly into their hearts, however darkened their eyes may be to the light of this world.

But there are other occupations which they are enabled to pursue, still more difficult than those which I have named.

FRANK. I cannot imagine what they can be.

MAMMA. I have read an account of an admirable institution in Paris, where the instruction of the blind has been carried to the greatest possible height, and where they are taught, not only to print and to bind books on the ordinary plan, but even to print them for their own use, and these they can learn to read without much difficulty.

EMILY. O, do tell us how, dear mamma.

MAMMA. Do you remember when I took you to see a printing-press, how the letters were arranged and formed into words?

FRANK. O, yes; the compositor had little boxes before him on his desk, and each of them contained a certain number of letters alphabetically sorted; and as he wanted to get a word arranged for printing, he picked out first one letter and then another, and put them into a little narrow frame till the word

was finished, and then he put a blank piece between that word and the next; and we were so surprised to see how quickly he performed his work. But how could a blind man know which to take out of the boxes?

MAMMA. Because a raised letter is affixed to the outside of each, by touching which he ascertains what is within it.

FRANK. Now, mamma, will you explain to us how the blind print books which they can read themselves?

MAMMA. Yes; when a sufficient quantity of type is arranged, the compositor takes a sheet of very strong paper, which he moistens.

EMILY. But does not that make it liable to be torn?

MAMMA. It would, if made too damp; but he is careful to avoid this, and then he lays it over his type. This, then, is either gently pressed, or struck again and again with a small hammer; thus an impression is made on the paper, which it retains when dry, so as to be perceptible not only to the sight, but also to the touch.

EMILY. But is not the impression soon effaced?

MAMMA. No; because when the paper was moistened, it was stretched; and it thus dried and shrunk again around the projecting parts of the type.

JANE. Then the blind learn to read by spelling out the words with their fingers, in the same manner as we do with our eyes?

MAMMA. Yes; and as we very soon begin to read words without spelling, by quickly passing our eyes over them, so in the same way they learn to read fluently by being familiarized to feeling them. I am happy to tell you, that the New Testament is now printing on this plan for their use, and that the Gospel by St. Matthew is already published.

JANE. Oh, mamma! how glad I am; may I get one, and give it blind Susan? I have been thinking of her all the time. Do, let me, and I will try and teach her to read? Oh, how nice that will be!

MAMMA. I should very much like you to do so, dear; and perhaps amongst us we might succeed in teaching her.

JANE. And then she could read to herself, in-

stead of your going so often, mamma, to read to her.

MAMMA. I have just heard of a plan, by which the blind are said to learn much more easily than by the ordinary method of printing. It has been invented, or rather modified from other plans, by a person of the name of Lucas.

FRANK. What is it, mamma?

MAMMA. He has alphabets made on the embossed plan I have described, on a soft metal plate, and from these the first lessons are given. The characters are not like those we use, but are more simple in their form, resembling those employed in shorthand writing.

EMILY. What advantage is derived from that alteration?

MAMMA. The strokes being fewer which compose the letters, there is less difficulty in discovering them by the touch; and in addition to this, the expense will be lessened of publishing the Scriptures.

JANE. How, mamma?

MAMMA. A smaller quantity of paper is required,

and also the words are much abridged, as in short-hand, when the pupil is sufficiently advanced.

FRANK. In what way is that done?

MAMMA. By generally omitting the vowels, and making the initial letter of a word, stand for the word itself.

JANE. Does not that make it very puzzling to read?

MAMMA. By no means.

FRANK. Is it difficult to learn this plan?

MAMMA. No; so easy, that some have learned it perfectly in a few hours; and one lady I heard of, was only a quarter of an hour in obtaining a knowledge of it.

FRANK. O, do let us all learn, and then we might get ever so many blind persons together and teach them.

MAMMA. You shall do so. I will shew you one of the alphabets which have been sent to me.

The accounts which I have received of the success of the method adopted by Mr. Lucas, are very delightful. I hope his benevolent efforts will meet with the encouragement they deserve. He is anxious

to make his plans known; and various friends, in different places, are raising subscriptions, in order to publish the Scriptures, by collecting the small sum of a shilling from every individual willing to contribute.

a b c d

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1 2 3 4 5 6 7 8 9 0

EMILY. Do let us open a subscription at once. How nice it will be to send Mr. Lucas some help, May I, dear mamma?

MAMMA. Yes, willingly; and here is the first contribution for you.

EMILY. O, thank you, dear mamma; this will be the best way to teach blind Susan, will it not?

MAMMA. Yes; I think so.*

FRANK. Then the blind might learn to write letters to their friends on some plan like this.

MAMMA. Yes; this art has likewise been taught to them; and they have been instructed in mathematical figures and arithmetical calculations by similar representations on paper.

FRANK. How much ingenuity has been called forth to supply the wants of these poor people, mamma.

MAMMA. Yes; and the necessities of our suffering fellow-creatures are constant calls upon our benevolence and kindness; and it also ought to be a

* Those who wish further information of the plan here described, may obtain it by applying to Mr. Lucas, 57, Castle Street, Bristol.

daily source of thankfulness to God, that he has preserved to us those precious faculties, of which they are deprived.

FRANK. I cannot think how it is that we forget so often all the comforts that we have.

MAMMA. There is only one source to which we can trace it, and that is the hardness of our hearts. If we loved God as we ought, we could not be so unmindful of his mercies, which he gives us day by day; we should make it our frequent prayer, as David did, that we might not do so. Do you not remember that he says in the Psalms,—"Bless the Lord, O my soul, and forget not all his benefits?"

EMILY. I wish I was not so ungrateful! We soon think of these mercies, if anything happens to deprive us of them. I never thought what a pleasure it was to hear, till the last time I was ill, when I was deaf for several days.

FRANK. And now, mamma, that you have told us so much about seeing, you will explain to us next about the ear, will you not?

MAMMA. Yes; I will endeavour to do so.

Conversation VIII.

ON THE EAR AND HEARING.

Emily. Dear mamma, now will you fulfil your promise of telling us about the ear?

Jane. I dare say that will not give you much trouble, because it is so very simple. There is nothing but what we can see,—just a piece of flesh which hangs out, and a hollow place through which the sound enters. The reason I think so is, because if I put my fingers in my ears, I cannot hear anything. Am I not right, mamma?

Mamma. You are right as to the sound passing through the hollow opening, but wrong in all the rest; for the mechanism of the ear is one of the most curious things possible, and so intricate, that it is much more difficult to understand than that of the eye.

FRANK. I quite long to hear about it.

MAMMA. The ear is divided into three parts:—First, the outward ear, or that which you see externally, from which there is a cartilaginous tube, which leads into the second part, which is called the Tympanum; and, thirdly, the Labyrinth.

EMILY. I can guess, that the last is the intricate part; because the other day we read about the labyrinth of Crete, out of which no one could find his way.

MAMMA. Yes; the labyrinth takes its name from that circumstance, for it includes all those intricate canals, which contain the expanded nerve, which is the seat of the organ of hearing.

FRANK. And what is the second part?

MAMMA. The tympanum is a cavity or hollow, in which bones and muscles are so placed, as to increase the strength of the vibrations of the air, which it first receives, and then conveys to the labyrinth, through which they pass to the brain.

But I must now give you a more minute description of each of these parts. You can tell me from

your own observation, whether the ears of all animals are formed alike?

JANE. O, no, mamma, certainly not; some have great long ears, and some such short small ones, you can hardly find out that they have any at all.

MAMMA. Which have long ears?

JANE. Donkeys, and hares, and rabbits, and many others.

MAMMA. Yes; and will not this help you to discover the use of the outer ear?

FRANK. I should think it was to collect sounds; because the safety of some of those creatures depends on their being able to do so.

EMILY. And they turn them about, too, to the place whence the sound comes.

MAMMA. And those animals, whose preservation from danger depends on flight, are endued with a remarkably acute hearing, and are enabled to catch very distant sounds.

JANE. That is a kind provision for those poor little creatures; but I am glad that we have not got long ears like donkeys.

EMILY. We read of a king, you know, who was said to have them.

JANE. Who was that,—do tell me the story?

EMILY. His name was Midas, king of Phrygia. It is related of him, that he found a great deal of money, which made him love riches exceedingly. Having done something to please the god Bacchus, he told him to choose what reward he would have, and he asked that every thing he touched should be turned into gold,—which was granted. Midas soon began to find the great inconvenience of this; for when he put anything into his mouth, it became gold, so he was almost starved. He begged very soon to have the boon withdrawn, and was ordered to bathe in the river Pactolus, whose sands turned into gold at his touch. Not long after he offended Apollo, who, in revenge, changed his ears to those of an ass. One of his subjects discovered this, and being afraid to repeat it, he dug a hole in the earth, and whispered the secret. When the grass and reeds grew up, it is said that whenever they were moved by the wind, they breathed out "Midas has asses ears."

JANE. What an odd story; I suppose it is not true?

MAMMA. No; but there is most probably some truth which it is intended to teach, which is hidden beneath a fable. There is much that we may learn from it, of the folly of wishing to have other things than those which God has seen fit to give us. But we have wandered away from our subject, which was ——?

FRANK. The adaptation of the ears of animals to their peculiar modes of life.

MAMMA. Yes; now, the ears of man, not being needed for the same ends as those of the brute creation, are differently placed.

EMILY. There is one animal, mamma, whose ears are like those of man,—I mean the ourang outang.

MAMMA. They are in a great degree, though the outer ear is larger; but this may be accounted for by the upright position of his body. The outer ear is formed of an elastic cartilage, covered with

thin integuments. Different names are given to the folds of it; and the part which hangs down is called the lobe.

FRANK. Then is the hollow part a bone?

MAMMA. The outer part of it is cartilaginous, but the inner is formed by the bone of the skull.

EMILY. Is it an even, straight hollow, like a tube?

MAMMA. No; this passage, which is called the Meatus Auditorius Externus, is oblique; it is covered with a delicate skin, from which grow many fine hairs. Underneath it are glands, which secrete the wax of the ear.

EMILY. What is the use of that secretion?

MAMMA, It, together with the hair, protects the ear from injury, and prevents insects, and other things which may enter it, from going any further. What was the second division called, of which I told you?

FRANK. The Tympanum. I know that means the drum, because it is the Latin word for a drum.

MAMMA. You are right. The Meatus Externus ends in a circular opening, over which is extended

the membrane of the tympanum. The tympanum is an irregular cavity, about half an inch in width, in which are two openings, one of which leads into the labyrinth. Besides these there is a tube, which extends from the tympanum, and opens behind the palate, called the Eustachian Tube, after Eustachius, a celebrated Italian anatomist of the sixteenth century, who first discovered it.

Emily. What can be the use of that? I cannot think, because we do not use our ears in eating.

Mamma. The object of this tube is to admit air into the tympanum, so as to preserve the balance of air between the outer and inner ear. I have often explained to you, that if there was only the external pressure of the atmosphere on our bodies, without any air or fluid within to resist it, we should be crushed to pieces. In the same manner, the pressure of the atmosphere on the membrane of the tympanum would be too great for it to support, unless there was a supply of air from within, to counteract it.

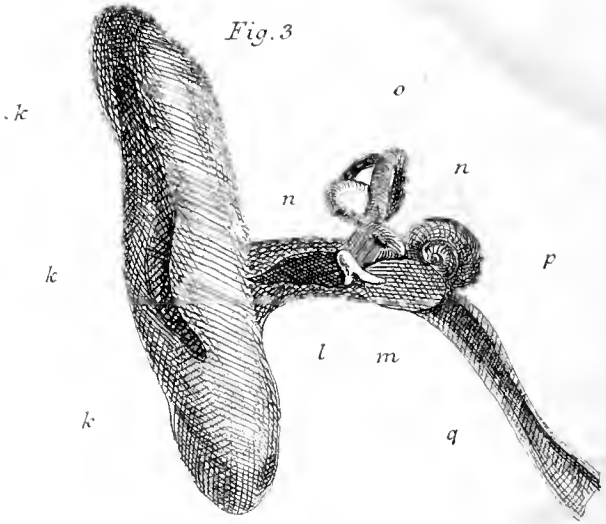
Emily. Thank you, mamma; I see now exactly the use of the provision.

Frank. You said that there were two openings

Fig. 1

Fig. 2

Fig. 3



in the tympanum,—have they any particular names given to them?

MAMMA. Yes; they are called the Foramen Rotundum, and the Foramen Ovale. I will show you a picture of a portion of the ear, in which you will see the foramen ovale. (See Plate III. fig. 1. *a*.)

JANE. Are they open holes?

MAMMA. No; they have each a membrane stretched over them. I shall tell you more about the particular purpose to which they are adapted, when I explain to you about the hearing itself.

FRANK. Is there any thing between these two openings?

MAMMA. Yes; a bony swelling, from which proceed some very small bones.

EMILY. May I ask, before you go on, mamma, what is the use of the membrane which is stretched over the tube of which you told us?

MAMMA. Yes; it is a very proper question. Its purpose is to convey the vibrations of the air, which are received through the outer ear, to the chain of bones in the tympanum.

FRANK. Is it stretched straight across them, like the parchment on the head of a drum?

MAMMA. No; on the contrary, it is funnel-shaped, that is, drawn down in the centre, from the weight of one of the four bones which adhere to it.

JANE. Is the membrane thick and tough?

MAMMA. No, it is transparent; but yet, like all the other membranes in the body, it is furnished with a great quantity of vessels.

EMILY. You were going to tell us about the little bones in the tympanum, when I interrupted you, mamma.

MAMMA. Yes; there are four of these very curious little bones in each ear, and they are so constructed, as to transmit to the foramen ovale the vibrations of the air, which are received on the membrane of the tympanum. They are articulated with each other, and fastened by ligaments, so as to form a complete chain.

JANE. I guess that they have got some muscles, too, that they may be able to move about?

MAMMA. You are right, Jane; they are formed in

such a manner, that they not only transmit the vibrations which they receive, but increase their force; whilst the small muscles, which I have just named, enable them to adapt the tension of the membrane to the strength of the impulse; and thus they both guard the ear against too violent shocks, and increase its power to hear weak sounds.

EMILY. How very wonderful!

FRANK. Have those four bones particular names, mamma?

MAMMA. Yes; and they are given to them because they are supposed to resemble the objects whose names they bear. The first is the Malleus: Here is a picture of it. (See Plate III. fig. 2. *a*.)

FRANK. That is the Latin for a hammer or mallet, is it not, mamma?

MAMMA. Yes; and you see that the shape of this little bone is like a hammer. Its form resembles the bone of the thigh. The body of it, which is like the handle of the hammer, is joined to the membrane of the tympanum. It is not equally thick all over the handle part, but has projections towards the head.

EMILY. What is the name of the second bone, mamma?

MAMMA. The Incus,—which means what? (See Plate III. fig. 2. *b*.)

EMILY. An anvil.

MAMMA. Yes; but this bone in reality is more like a large double tooth, with a hollow in the centre, into which the malleus or hammer strikes or falls. The shorter leg, and the body of the bone, lie on the margin of the circular opening of the tympanum. The long leg hangs down into the tympanum, and is joined at its point to the third bone, which is called the Os Orbiculare, (See Plate III. fig. 2. *c*.)

FRANK. That means a round bone, does it not?

MAMMA. Yes; this is the most curious, because it is the smallest bone in the body. It is not larger than a grain of sand, and yet, without it was in its place, the whole chain would be imperfect. But there is yet another bone to complete the series,—this is called the Stapes, which means what? (See Plate III. fig. 2. *d*.)

FRANK. A stirrup.

MAMMA. Yes; and is it not really very much like one in shape? only it is elegantly grooved within.

EMILY. And has it a hole at the bottom, like a stirrup?

MAMMA. No; but its base is flat on one side, in order that it may be fitted to the foramen ovale, as it is fastened to the membrane which is stretched over it.

JANE. I am sure you were right, mamma, in saying that the ear was not so simple a thing as I was foolish enough to imagine.

EMILY. But mamma has not yet described the labyrinth, which is the most intricate part of all.

MAMMA. True, my dear; but I must first tell you, that the little chain of bones with which you are now acquainted, is so wonderfully arranged, that each one of them performs the exact office which is required, in order to convey sound to the nerve, through which the sensation of hearing is communicated to the brain. Repeat to me the names of the four bones.

FRANK. The Malleus or hammer.

EMILY. The Incus or anvil.

FRANK. The Os Orbiculare or round bone.

EMILY. And the Stapes or stirrup.

MAMMA. We now come to the third division of the ear, which is called what?

FRANK. The Labyrinth.

MAMMA. This is the internal ear, or the proper seat of hearing,—all the others, or mere outward parts, being formed to act upon this.

FRANK. Does it consist of only one cavity?

MAMMA. On the contrary, the labyrinth is divided into the vestibule or middle cavity, the semicircular canals, and the cochlea. The picture which I shewed you before is a representation of this part of the ear, with the bone taken away by which it is really surrounded in the head. The labyrinth takes its name from the extreme intricacy of its form, and from the many windings which there are in it.

EMILY. Does the middle cavity contain air, as that of the tympanum does?

MAMMA. No; it contains an expanded nerve, in contact with which there is an aqueous or watery fluid.

EMILY. What is the form of the vestibule?

MAMMA. Its form is oval, and the bore is very small.

FRANK. What do you mean by its bore, mamma?

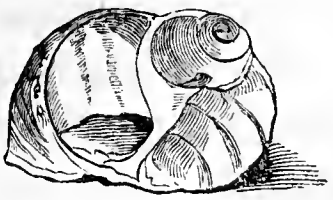
MAMMA. The bore is the hollow or perforation of a tube. Of what does the second division of the labyrinth consist?

FRANK. Of the semicircular canals.

MAMMA. There are three of these. (See Plate III. fig. 1. *b. b. b.*); but their positions and leadings are so extremely intricate, that even if I attempted a description of them, you would not understand it. We will therefore pass to the third division, which I told you was called—what?

EMILY. The cochlea.

FRANK. I think that is Latin for a snail-shell; so I suppose that there is something in the form of this part of the ear which resembles that shell,—is there not, mamma?



MAMMA. Yes; you have observed in a broken snail-shell, that there is a kind of spiral tube, round which the curling part, or the whirls, as they are called, are twisted. Just so it

is with the cochlea, (Plate III. fig. 1. *c.*); the circles at the base being the largest, and each getting gradually smaller till they reach the top.

FRANK. And what is the use of the pillar, and of the whirls?

MAMMA. Both the pillar, and the circles which surround it, are of the most exquisite structure, and through them part of a nerve is conveyed and protected. But, as I said of the semi-circular canals, it would be useless to give you more than a general outline of this section of the ear; its construction is so curious and involved.

FRANK. Why, then, mamma, do you think that this form was chosen?

MAMMA. That question is easily answered, my dear; for the more closely the conformation of the ear is examined, the more clearly is it discovered that every part of it is exactly adapted for the conveyance of sound to its nerves and to the brain.

EMILY. Mamma, have all the minute divisions of the ear, which you have described, the same provision of vessels and membranes as the other parts of the body?

MAMMA. Yes, they have; the vestibule, the semi-circular canals, and the cochlea, have each their periosteum, which is vascular, or supplied with vessels and soft membranes, which contain a fluid.

EMILY. Is the base of the ear part of the skull?

MAMMA. Yes, my dear; it is formed on the side of the temporal bone, into which the nerves of the ear pass. Now repeat to me the substance of what I have told you. How is the ear divided?

FRANK. Into the outer ear, the tympanum, and the labyrinth.

EMILY. The outer ear is that which we see, which is partly cartilaginous and partly bony.

JANE. The tympanum comes next. It is a hollow, with two holes in it. It has got a membrane over it, and so have they; and there are four funny little bones in it, which are fastened together, and beat upon the membrane, like little drum-sticks.

EMILY. The labyrinth is the most difficult part of the ear to understand, and is divided into three portions, *i. e.* the vestibule, the semi-circular canals, and the cochlea.

MAMMA. Very well. I will show you one more

picture, which will give you a clear view of the relative positions of the parts you have described, and you must tell me the name of each, from what you already know.

EMILY. Shall we point them out in turn, mamma?

MAMMA. Yes, do so.

EMILY. (Plate III. fig. 3. *k*, *k*, *k*.) is the external ear, which is cartilaginous.

FRANK. (Plate III. fig. 3. *l*.) is the meatus auditorius externus, which you said was oblique, and we can see that it is so here.

JANE. I don't know what (Plate III. fig. 3. *m*.) is, mamma.

MAMMA. It is the membrani tympani.

JANE. May I say (Plate III. fig. 3. *n*, *n*.) I think I know that?

MAMMA. Yes.

JANE. Does it not point out those four little bones that strike on the tympanum. O, yes, I can see them all, and that very, very little bone so clearly.

MAMMA. Yes, my dear, it is so.

EMILY. (Plate III. fig. 3. *o*.) must be the semicircular canals.

JANE. What does semi-circular mean?

MAMMA. Half a circle; which, you observe, is the form here.

JANE. Yes; if they had been round, they would have taken up too much room, I suppose?

MAMMA. And not have transmitted sound so well.

FRANK. (Plate III. fig. 3. *p.*) is the cochlea.

JANE. Emily, you must say, it, (Plate III. fig. 3. *q.*) for I do not know it.

EMILY. Mamma, am I right that it is the Eustachian tube, which goes from the ear to the back of the palate, and contains air?—I guessed so from its position.

MAMMA. Yes, dear; you are quite right. Now I hope you all have a tolerably clear idea of the interior construction of that curious member of our bodies, through which so much pleasure and instruction comes to our minds. I will therefore next explain to you about the faculty of hearing. In the same manner as the eye is the instrument through which impressions, relating to the *appearances* of things, are made upon the brain, so the ear is the

organized instrument, through which *impressions* of *sound* are conveyed to it.

Sound is produced by air, which is put in motion by striking against a sonorous body.

FRANK. Do you mean, mamma, that air is essential to sound, and that if there was no air there would be no sound?

MAMMA. Yes; that can be proved by experiment. There is a machine called an air-pump, by means of which all the air can be withdrawn from under a glass connected with it, which is called an exhausted receiver. If a bell, which has previously been suspended there, is rung, when the air is all gone, no sound whatever is heard.

FRANK. That does prove it, indeed, most satisfactorily; how I should like to see an air-pump!

MAMMA. You shall see one, my dear, and have the principle upon which it acts, clearly explained to you.

FRANK. Thank you, mamma.

MAMMA. Air is a fluid.

JANE. Like water, mamma?

MAMMA. No; water is a liquid, that is, it can

be separated into drops, which is not the case with air; but it has several properties in common with water, one, particularly, which is, that it always finds its level.

EMILY. I do not quite understand you, mamma.

MAMMA. There is a principle in nature called gravity, which means, that all bodies have a tendency to fall towards the centre of the earth. Water, therefore, and air, and all fluids, being once displaced, fall again, till they have reached the lowest point to which they can go,—that is, till every particle has sunk to its level. Now, if you apply this to the air, you will find that when it is driven out of its level, it seeks it again, and this causes vibration or movement in it; and when, in these vibrations, it meets with a sonorous body, sound is the result.

EMILY. Are there, then, waves in the air, as there are in the water?

MAMMA. Yes; and if you remember the effect which is produced if you throw a stone into the water, which forms circle after circle, till the larger and outer one is so faint, that you can scarcely see it, you will understand how the air is similarly affected;

and that the undulations in it, in proportion to their distance from the place where the sonorous body was struck, are fainter and fainter, till at last no sound is heard. Sound travels at the rate of 1130 feet in a second; light travels with much greater rapidity; so that, if you stand at some distance from the spot where a gun was discharged, you will see the flash long before you hear the report of it.

FRANK. I suppose that is the reason why we do not hear thunder and see lightning at the same time?

MAMMA. It is; and when there is but little space between them, we say that the storm is immediately over our heads. The waves of the air are collected by the outer ear, the trumpet-like shape of which conveys the sound to the membrane of the tympanum. Behind this is a cavity containing air, otherwise the membrane would not move backwards and forwards, as it does when it is acted upon by external vibrations. Then the chain of bones increases the vibration received on the membrane of the tympanum, and transmits it to the membrane of the foramen ovale.

You remember that in the cavity of the tympanum there were two openings, called the foramen ovale, and the foramen rotundum, both of which lead into the labyrinth. The former leads also into the vestibule, and the latter into the cochlea; each of these has a membrane stretched over it. Thence sound passes through the various intricate canals I have before described. The soft expansion of the nerve, in the three divisions of the labyrinth, receives the undulations of the contained fluids, and these motions give to the nerve and brain the sense of hearing.

FRANK. I think, in some respects, that this is more curious than the account of the construction of the eye, because through the eye we get impressions of things which really exist; but through the ear, of those which come from the minds of others, and go to our brain, and make us feel and think of things which we never felt before.

MAMMA. Yes; this knowledge reminds us of what the Psalmist says, "It is high, I cannot attain unto it." But you must always remember, my dear, that though outward things *seem* to you more real

than those which are merely mental or intellectual, or have only to do with the mind, that they are not so in fact, and by studying the anatomy of the ear, we may learn this truth. There is another thing, also, which I should wish you to observe, and that is, that it is possible for the outward ear to look quite perfect, and to catch all the sounds which the vibrations of the air produce, and yet, if the inner and hidden parts of it are diseased or imperfect, no sensation will be communicated to the brain,—this is the case with whom?

Emily. With deaf persons, mamma.

Mamma. And what important Scripture truth does this teach us, with regard to ourselves?

Frank. Do you mean, mamma, that merely hearing the Gospel will not do us any good, unless we receive it into our hearts?

Mamma. Yes, my dear; all the Jews to whom Christ himself preached the Gospel, heard him with the outward ear; but did they all of them derive equal benefit from it? No; some of them merely increased their own condemnation; because, seeing they saw, but did not perceive, and hearing they

heard, but did not understand. Let us therefore take heed how we hear, and remember that it is only Christ in the heart, and not Christ in the understanding alone, which will do our souls any real good.

Conversation IX.

Anecdotes of the Deaf and Dumb.

Mamma. I have convinced you, I hope, that compensation is made for great and trying losses, by the gracious manner in which God causes one faculty to supply the place of another?

Frank. Yes, mamma, in the case of the blind; but I think there is something worse to bear than blindness, and that is, if one should be deaf and dumb; because I cannot conceive how persons born in that state could learn anything, or have any means of communicating what they felt, to others.

Mamma. In that conclusion, I am glad to say, you are wrong; for they can be taught almost as well as those who possess all their faculties.

Jane. Oh, mamma, do tell us how. Did you

ever see a deaf or dumb person who could make you understand what he meant?

MAMMA. Yes; a gentleman so afflicted once called at our house. Your papa, who was the only person with whom he was acquainted, was from home; but he expressed his meaning so well by signs and gestures, that we could, with the help of a map which hung up in the room, and on which he pointed out several places, keep up a tolerably intelligible conversation with him; and we should have done so without the least difficulty, if we had understood the useful art of talking with our fingers.

JANE. How do you mean, mamma?

MAMMA. Every letter is expressed by some position of the hand, or by pointing to a certain finger. A person who has learned this art thoroughly, can communicate with a deaf person, almost as easily through this medium as by conversation.

EMILY. How curious! but how slow it must be, after all; for if we spelt all our words, we could not say much.

MAMMA. You are mistaken; for I am acquainted

with those who do it with such rapidity, that their fingers appear to be in perpetual motion; and they can convey to another, either the whole of the conversation that is going on, or at church, the sermon as it is preached, or the speeches in a public meeting.

JANE. Everything you tell us, makes me more surprised.

MAMMA. When this language has been taught, communication may be held by it, even in the dark, by pressing on the fingers of the individual, to whom the conversation is addressed.

FRANK. And is it difficult to learn?

MAMMA. Not at all; I can show you a printed sheet, in which both the letters and the position of the hands are represented so clearly, that any one might teach it to himself.

JANE. But, mamma, how do you know when one word begins and another ends?

MAMMA. Some persons put their hands together between each word, and slide the right hand over the fingers of the left; others make a slight pause; but

those who converse with great facility never stop between the words, and they get so accustomed to this mode of talking, that it becomes unnecessary.

FRANK. Are there particular schools for teaching these unfortunate people, and masters employed to instruct them in a different manner to other children?

MAMMA. There are; but some of those who have had the most experience, think that if the deaf and dumb were sent to schools with other children not so afflicted, they would make much greater progress than if they were always associated together.

FRANK. And do you think so, mamma?

MAMMA. Yes, dear; I have been for a long time persuaded of it, and have often wished to make the experiment.

EMILY. What makes you suppose that they would learn better so?

MAMMA. Because children very quickly gain ideas and knowledge from those by whom they are surrounded, even if the teaching is not directly addressed to themselves; and the more intelligent their companions, the more they would necessarily learn.

But if shut up with those similarly deficient with themselves, the compass of ideas they would acquire would be confined within very narrow limits.

FRANK. Yes, mamma; I am sure you must be right in that, but has your plan ever been tried?

MAMMA. Yes; and with the greatest success in the case of a remarkable individual of the name of Arrowsmith. His mother, who was a very clever and sensible woman, determined that he should go to the same school with his brothers, where he got on as quickly as they did.

FRANK. I can easily see why a person who could not hear would get on well, when he had once acquired something; because he would have so much less to divert his attention from what he learned, and consequently would preserve more securely what he had already gained. But then, I do not at all see how he can first get ideas on any subject.

MAMMA. In a very simple way. Words are but the signs of thoughts, are they?

EMILY. No.

MAMMA. Then you must have thoughts in your mind before you express them, must you not?

EMILY. Yes.

MAMMA. The first object, then, to be sought, in teaching a child, is to make it acquainted with *things*.

EMILY. Yes, certainly.

MAMMA. Well, suppose that we all went into a foreign country, where we could not speak a word of the language, we should be nearly in the same situation as a deaf and dumb person, should we not? Because, though we heard what the natives said, we should not understand what it meant.

JANE. Yes.

MAMMA. What then would be the first thing you would do?

EMILY. I should make all sorts of signs to them, to show what I wanted.

MAMMA. Yes; this is what we may call the natural language, by which we can speak to each other; and we use action very often, when we can and do speak, as either conveying more than words, or to give greater force to them.

JANE. Yes, mamma; when you shake your head or look very grave, I know that I have done some-

thing which displeases you, even if you do not say anything to me.

MAMMA. Now, if you apply this to the manner of teaching the deaf and dumb, you will soon see that it is both possible and easy to convey instruction to them.

FRANK. Do explain to us, mamma, exactly how this is begun.

MAMMA. In order to teach children to read and spell, they are first instructed in the manual alphabet, which they soon imitate with their own fingers; then the letters corresponding with these signs are shown to them one by one, both in large and small print, till they know them perfectly. The next thing is to select some object with which they are familiar, such as a table. Point several times to this, and then pick out the letters which spell the word, and lay them before them, till they know well which have been used; then mix them together, and return to them the word thus, which they will soon re-arrange, till they have learned the word perfectly. Whenever, therefore, they meet with this word in a book, they

will know to what object, or kind of object, it refers.

JANE. That is just on the same plan as you taught me to read, mamma.

MAMMA. Yes, dear, just the same. Now, think of other words,—such as head, hand, chair, eye, nose, mouth, lips, feet,—in short, every object with which a child is familiar, and he will soon get acquainted with them in the same way.

FRANK. Yes; that I can now quite understand, and everything he learns must be such pleasure to him, because he knows so little, that perhaps he will be a steadier scholar than some children who have all their faculties.

MAMMA. Yes, it has been found so. How many new words do you think a deaf and dumb person will learn in less than three days, on the plan I have pointed out to you?

FRANK. Twenty, mamma?

MAMMA. More than four times that number.

JANE. Oh, that *is* quick! Then they would soon know a great number, indeed.

MAMMA. When the pupil can spell the words,

then the next thing that is done is to give him cards on which they are printed, and pointing to some piece of furniture in the room, or to some part of the body, ask him to give you the card on which he finds the name. This is a great amusement to him, and it helps to impress it very deeply on his mind.

FRANK. I can see, mamma, how the mere substantives can be thus learned without difficulty; but then how many parts of speech there are which have no relation to outward signs, and which could never be taught through that medium.

MAMMA. Much fewer than you suppose. Indeed, the good Abbé de l'Epée, invented a system by which he instructed the deaf and dumb, with the greatest success, in every part of grammar, by which he made them acquainted, not only with the different classes of words, but also with the rules of syntax, and the method of composing elegantly.

EMILY. Do, mamma, give us an instance, for I cannot understand how that could be done?

MAMMA. To enable him to understand, suppose the verb *to carry*, and the pronouns with which it is conjugated, the Abbé proceeded thus:—He stood by

a table, with his new scholar at his right hand, surrounding it also with other deaf and dumb children. He put his left fore-finger on the pronoun *I*, which was written down, and with his right fore-finger tapped several times against his own chest, to show him who that word represented. Then he took up a very large book, and walked about the room with it, either on his head or under his arm, or in some conspicuous manner, showing to his pupil that this action referred to the word *carry*, to which he had previously pointed his finger. Then, in order to explain *thou carryest*, he put his finger on the pronoun, pointed to the boy with his other hand, and showed that *thou*, meant him, and *carriest*, the action he was to perform. The same book was then given to him, and he had to do with it what his preceptor had just done. Then to teach the third person, some one else was pointed out, and by signs desired to do the same. This being all finished, a line was drawn under *I*, *thou*, and *he*, to show that these words needed no further explanation. The plurals were taught in a similar manner.

JANE. How funny! I should like such grammar lessons as those must have been.

MAMMA. In this way the Abbé proceeded, with the most unwearied patience, till he had discovered a method of conveying to the minds of his pupils, every part of grammar, and enabled them to read, and express their thoughts with ease, either by signs, or by writing, or by using the manual language. I could easily explain all his plan to you; but as I have his book, which you shall read, you will understand it more clearly than I could lead you to do in one conversation.

FRANK. Thank you, mamma. There is one thing that still puzzles me, and that is, how the deaf and dumb can get at ideas, which have merely relation to the mind; or if they have these in their minds, how they can be taught which words express them?

MAMMA. This does appear, at first, an insuperable difficulty; but it is not so, though it required great ingenuity to discover how to do this. Now, whatever the idea may be which we want to express,

there are generally many words of like, if not of precisely the same meaning, some of which may be explained through the medium of significant signs. Perhaps it may require many, or all of these together, before the word we want can be fully comprehended. I will give you an instance, which the Abbé produces in his work, in order to show how the most abstract ideas may be made comprehensible. He wanted to explain to his deaf and dumb pupils the meaning of the word *believe*. This included the idea of assent with the mind and heart, expressed by the mouth to a thing not seen. He did it thus:—He wrote down on a table

I believe
—I say *yes* with the mind. I think *yes*.
—I say *yes* with the heart. I love to think *yes*.
—I say *yes* with the mouth.
—I do not see with my eyes.

You remember how he had previously taught them the meaning of the pronoun *I;* therefore, when he pointed to it, they knew what he meant. Then he put his finger to his forehead, which they knew alluded to the mind, and made a sign which signified *yes;*

this explained the first sentence. Then he pointed to his heart, and again made the sign for *yes*. This explained the second. Then he moved his lips, saying *yes*, which motion, though the deaf cannot hear, they well understand. And, lastly, he put his hand over his eyes, and made the sign for *no*, to show that he did not see. Then, pointing to the words *I believe*, from which lines were drawn to all the four sentences, it was clearly understood by his pupils, that *I believe* meant all these things.

JANE. Oh, but what a time it must have taken to make all these signs.

MAMMA. So far from it, that his own expression is, "they were made in the twinkling of an eye."

FRANK. Well, this is wonderful! I quite see what the plan is; but in order to be perfect in it, I should like to have a poor child to teach myself. How very interesting it would be, to invent all sorts of ways to try to instruct him.

MAMMA. It would, indeed; and if amongst our poor neighbours, we can hear of such an object of compassion, I shall be very happy to gratify your wish, and to do all I can to help him likewise.

EMILY. And, mamma, if we sent him to the Infants' school, do you not think he would learn there very quickly, because the children are taught so much from pictures and objects ?

MAMMA. Yes, I think he would learn there better than anywhere else, and I have been for some time desirous of trying the experiment. It would have a double advantage, as it would teach those children who were in possession of all their faculties what blessings they possessed; and it would also be a good opportunity to lead them to show kindness to their poor little companion who was destitute of them.

FRANK. Are there are a great many persons in this situation ?

MAMMA. It is calculated that in every country the number amounts to about one, in less than three thousand. I have shown you that it is quite possible to give the most intellectual instruction to these poor afflicted persons, and now I will give you a few convincing proofs how well they understand it. The following are the answers which some children wrote on a slate, in reply to questions which were proposed

to them; one of these was—What is despair? To this the boy replied—Despair is the expectation of a certain evil; the sailors despair when the ship breaks, and the large waves fall upon them.—Despair has no hope.—Despair has a pale face. The great murderer despairs when the judge says that he must be hanged.—Despair is fear without hope.—Despair is darkness in the mind.—Despair does not love play.—Despair is idle.—Despair is wildness in the mind.—Despair has no pretty home.

Emily. That was a beautiful answer; do, mamma, tell us some more.

Mamma. Another was asked—What is hope? To which he said—Hope is desire joined with belief.—Hope is a mental looking towards a happy state, with a desire to attain it.—Hope is the soul's sunshine; its support and comfort under toil and hardship.—Hope is the staff of life, it cheers us in affliction, and supports us in our journey through life. If we meet with disappointment, we look for better days; and if we are poor and needy, hope tells us to pursue industry and improvement, and we shall obtain sufficient to support us in this world.

FRANK. That was very clever, and I think it shows indeed that he well understood the question.

MAMMA. Yes; some one else demanded — What is the difference between reason and judgment? and the answer given was — Reason is the torch, and judgment the guide of the mind.

FRANK. I like that the best of all.

MAMMA. I think that these children displayed much talent in the choice of their illustrations. The following reply to the query,—What is memory? proves this. I came from Dawlish; I can draw in my mind its houses, the sea-shore, and my mother's house. I can see the town of Dawlish in my mind; this is memory.—Memory is the portrait gallery of the past. I can look upon my school-fellows, and my home; I can remember when I was a little boy, but I cannot see these things with the eyes of my body; they are in my memory.—Memory is a mental cabinet that receives my ideas, and holds my thoughts.—Memory is like a drawing master, it shows me the form of my parents.—Memory paints in my mind what I wish to keep long.— Memory is the consciousness of what is gone, or was done yesterday, or some time ago.

EMILY. How they seem to discern the nice distinctions between words, which it is often so difficult to express. Can you tell us some more of their answers mamma?

MAMMA. There was a reply given to the question —What is contentment? which pleased me much. It was this — Contentment is enjoyment without anxiety, and satisfaction without desire. It does not look with envy at the greatness of another; nor seek to enlarge its possessions by ambition or meanness. —Contentment is an even state of mind, that asks for no more than what it possesses. But one of the most beautiful replies which I remember, was given by a mute, who was asked,—What is gratitude. He answered—The memory of the heart.

EMILY. Oh, that is beautiful indeed! I think that these deaf and dumb persons are cleverer than those who have all their faculties.

JANE. But you don't wish to be like them sister, I hope? I am sure I do not.

EMILY. No, Jane; but still I must admire them much, and I begin to think that they may be happy too.

MAMMA. You are quite right dear, and a singular proof how the mind may be brought into a state of submission, even to the heaviest privations, was given by a boy, to whom a gentleman proposed the following questions. He first wrote on a slate,—Who made you? The answer was promptly given in the words of Scripture.—"In the beginning, God created the heavens and the earth." He was asked —Who redeemed you? To which the boy replied, —"God so loved the world that he gave his only begotten Son, that whosoever believeth in him should not perish but have everlasting life." The gentleman then wrote,—Why did God make you deaf and dumb, whilst other children see and speak? The child looked much amazed, and gave evident signs that he felt the impropriety of the question, and then wrote down—"Even so Father, for so it seemed good in thy sight."

FRANK. That was very sweet; he did, indeed, bow to God's will.

MAMMA. Another boy of the name of Le Clerc, who was similarly circumstanced, was asked, if the deaf and dumb thought themselves unhappy? Le

Clerc replied—He who never had anything, has never lost anything; and he who never lost anything, has nothing to regret; consequently, the deaf and dumb, who never heard and spoke, have never lost either hearing or speech, therefore cannot lament either the one or the other. And he who has nothing to lament cannot be unhappy; consequently, the deaf and dumb are not unhappy. Besides it is a great consolation for them to be able to replace hearing by writing, and speech by signs.

Emily. That is an admirable reply indeed, and a most convincing one; for though they know that others have faculties which they have not, yet no one can apprehend the value of a blessing which he has never possessed.

Mamma. Though deprived of the power of hearing the voice, they learn very soon to watch the movements of the lips, and can often distinguish what is spoken by this method only. When great attention is paid to their early training they may derive much pleasure even from sound, and particularly from music.

Frank. Oh mamma, how is that possible?

MAMMA. Have you not often amused yourself, when I have been playing on the piano, by putting your ear near the sounding board, and watching the curious tremulous motion that was occasioned both there and on the wires, by the striking of my fingers on the keys?

FRANK. Oh, yes.

MAMMA. And still more, if you are sitting even at a considerable distance from the organ at church, have you not felt a strong vibration from it?

EMILY. Yes, I have constantly noticed it.

MAMMA. Now, by directing the attention of these sufferers to this circumstance, they have been led to enjoy music, as much or more than many of those who hear distinctly. Mr. Arrowsmith, whom I have before named to you, used to attend at concerts, and had the most correct perception of the sounds which he heard, and particularly delighted in those parts of the music, in which the modulation was the finest.

EMILY. Do tell us how he could manage to feel on such occasions, because he could not put his ear against one particular instrument?

MAMMA. No; he used to place himself against

some wooden piece of furniture, or by a door or shutter; and then he fixed his nails, (which he kept long for the purpose) into it. He then felt so distinctly, that those present remarked the extreme delight which he manifested.

JANE. Well, mamma, you tell us one wonder after another; this is like the blind feeling colours; but we could not say that Mr. Arrowsmith had a good ear, for he heard through his fingers' ends.

MAMMA. When I explain to you about the sense of touch, you will find that the fingers are the principal seat of it, and that the nerves which carry it to the brain are placed there. I conclude, therefore, that it was thus, that sensations of pleasure were conveyed to him.

JANE. I wonder no method has been discovered to teach these people to speak; for it seems that they might do that, even if they could not hear.

MAMMA. This has been done, but the sounds which they utter are so harsh and disagreeable, and the process of teaching them so difficult and painful, that those persons who are the best qualified to

judge, think that it is better to omit this part of their education.

FRANK. Will you explain to us, mamma, how they are taught to speak?

MAMMA. The Abbé de l'Epée taught the vowel sounds, *a*, *e*, and *i*, by putting the third or fourth fingers of his pupil into his mouth, having first shown him in writing the letter he was about to articulate; having done so he put his own fingers into his pupil's mouth, and made him, as nearly as he could, do the same thing; that is, place his tongue in a similar position with relation to his palate, which by breathing at the same time causes the utterance required. The rest of the letters were principally taught by leading him to observe the movement of the mouth in pronouncing them; and also by pressing on the throat, and making him feel the effect of the breath on the hand, to convince him that unless that is put forth at the same time, the mere motion of the lips will cause no sound. From letters a teacher proceeds to syllables, and from syllables to words; but it is a tedious process, and often being very pain-

ful to the pupil, because part it of consists in pressing strongly on the throat, and also on the back of the neck, to show the different effects produced on those parts by the act of pronouncing words. You may easily conceive, that unless this was done by a very patient as well as gentle teacher, it might become not only irksome to the pupil, but also most distressing to his feelings.

Emily. Yes, mamma, it seems to me that you are quite right in saying that it is much better to give up the attempt of teaching them to speak, as after all it will not be of much use, since they cannot learn how to regulate their voices.

Mamma. There have been many interesting accounts published respecting the deaf and dumb, but none that seem at all equal to one of a young Irish boy, who was taken from the grossest ignorance and darkness, and taught not only reading and writing, and human wisdom, but the knowledge of the glorious Gospel of the blessed God, through the instrumentality of a lady who took a very kind interest in this poor child. She has published a short memoir of him under the title of the Happy Mute.

JANE. Oh, mamma, that is another proof then that they are happy.

MAMMA. This boy was so in a remarkable degree, after the Holy Spirit had changed his heart, and taught him what great love Christ had shown in laying down his life for him. He had many doubts and difficulties before he was willing to believe these things; but his kind instructress used every possible means to enlighten his mind, and never ceased to pray that he might be truly taught of God. She gives an account of the first deep impression made upon his heart in the following manner.—"The way to this memorable conversation was opened whilst I was secretly praying that the Lord would point it out, by John expressing some curiosity as to what became of people whom he had seen carried past to their burial. He signified that their eyes were shut very close,—would they ever open them again?

"Upon this I threw down my needle-work, and bespeaking by a sign his most serious attention, I sketched upon a paper, a crowd of persons of all ages, and near them a large pit with flames issuing from it. I told him that the crowd contained him,

me, everybody; that all were bad; that God was angry; and all must be cast into that fiery gulph. He exhibited great dismay and anxiously looked for further explanation. I then drew a single figure, who came, I told him from heaven, being God's Son; that he asked his Father not to throw those people into the fire; and consented to be nailed to a cross to die, and that when his head drooped in death, the pit was shut up, and the people saved. It may well be supposed that I greatly doubted the possibility that such a representation, explained only by signs, should convey any clear idea to the boy's mind; but it is God's will, by the foolishness of preaching to save them that believe; and I had immediate tokens of His assisting powers, for John, after a pause of wonder, started an objection most delightful to me, inasmuch as it proved that he had laid hold on the grand doctrine of substitution. He observed, that the sufferer on the cross was but one; that the ransomed crowd were many, very many; and he signified his doubt of God's being satisfied with the exchange. The Lord still helped me; I took off my ring, laying it by itself on the

table, and then breaking into many pieces the leaves and stalks of some decayed flowers in a jar, I heaped them near it; asking, with a smile, which he would have, the one piece of gold, or the many withered fragments? Never shall I forget his look — the beautiful, the brilliant look of sudden apprehension —the laugh of delight—the repeated clapping of his hands, whilst he declared by animated signs, that the single piece of gold was better than a room full of old flowers; that the former was like Him on the cross, the latter like men, women, and children; and he spelled most exultingly, 'one! one!' Then with his countenance softening into the loveliest expression of grateful reverence, he looked up, saying "Good, good *One*," and ran for the letters to spell His name,—that adorable name, which is above every name; that name of Jesus, at which every knee shall bow. I taught him to spell it, and then I told him how Jesus Christ was laid in the grave; how on the third morning he burst its bars; how he rose to the Father, and would also raise him and me from the dead; and, finally, I assured him that Jesus Christ could see and hear us always; that we might talk to

him constantly, and hereafter be with him in heaven. I should have remarked, that when showing John the pit of flames, I paused to convince him that he for one had made God angry; he freely confessed it, by sorrowful looks and gestures, but most vehemently denied that God could be angry with me. Thus he was clearly brought acquainted with the plague of his own heart, and not the slightest objection did he make to the justice of a dreadful sentence against him. This struck me the more, because he was exceedingly jealous of his own rights and reputation, never resting for a moment under any supposed invasion of either; yet had he nothing to reply against God; he tacitly acknowledged his guiltiness, and it was a most glorious proof of divine teaching, that he never once appeared to question the *love* of God, even in delivering his own Son to a cruel death. I saw with unutterable, and overflowing joy, that my poor boy received Jesus Christ as His Saviour; and never from that happy hour to the moment of his death, did he seem to doubt his interest in the atonement."

FRANK. Oh, mamma, how very beautiful, do let us read the whole book?

MAMMA. You shall my dear; it is a wonderful illustration of that blessed declaration of God—"I will work, and who shall let it." No outward impediments, no blindness of the heart and mind, can hinder the power of that Spirit which is like "a hammer that breaketh the rock in pieces."

EMILY. I wish the book was a great deal longer, I should so much like to hear more about the happy Mute.

MAMMA. I wish very much, with you, that a longer account should be written of this interesting boy. He died most happily, at the age of nineteen, in the full assurance of faith. Those who knew him have described him to me as a peculiarly interesting and striking person; and the book which records his brief history, has been greatly blessed of God, to the good of many souls.

FRANK. I hope that all the poor creatures who were born deaf and dumb, up to the time when the good Abbé de l'Epée lived, and the other kind peo-

ple who have lately taken an interest in them, were not quite neglected, and left to pine on in their darkness and ignorance?

MAMMA. No; there have been many individuals in different countries and at different times, who have interested themselves on their behalf. The earliest period at which we hear of any effort being made for their instruction, was at the close of the 16th century, by a Benedictine monk in Spain, of the name of Peter Ponce, and his plans are said to have succeeded; but it is not known what they were. In 1620, another Spaniard of the name of Bomest, wrote on the subject. About thirty years after, it was taken up in Germany; but nothing appears to have excited any general attention to the matter until 1690, when a Swiss physician, living in Holland, named Amman, acquired great credit, by instructing a very beautiful girl who was born deaf and dumb. He afterwards published a work in which he described the method which he had pursued.

The fact having been thus clearly established, that mutes were capable of receiving education, individuals, in this and other countries, wrote on the sub-

ject, and used various means for their benefit, which have gradually brought about the formation of institutions for their special instruction, and stirred up the minds of many to labour and pray for those, who would otherwise have sat in darkness and the shadow of death. Let us remember that the humblest, and poorest, and youngest amongst us, may do *something* for the good of his fellow creatures; and let us each bear in mind, that class about whom I have been talking to you; and whenever we meet with one of them, let us use every effort in our power to ameliorate their condition; and if we can do nothing else, let us at all events pray earnestly on their behalf, to Him, who can, in a spiritual sense, "unstop their deaf ears," and "make the tongue of the dumb to sing."

Conversation X.

on the nose and smell.

Mamma. As I have given you some idea of the manner in which you see and hear, I will now try to explain to you what relates to the other senses.

Frank. I think that smelling cannot be so difficult to understand as seeing and hearing, because it takes in so few objects, compared with the other senses.

Mamma. You are correct there; but still, the nose, from its position, and its being the canal which leads to other important parts of our frame, has, like the rest of our bodies, been formed with admirable skill, and is more intricate in its internal construction than you would suppose.

Emily. I do not quite understand what you mean

by speaking of it as a canal which leads to other parts of our bodies,—where does it lead to mamma?

MAMMA. Suppose you enter a room in which there is something burning, which has a noxious smell, where do you immediately perceive the effects of it, even if you keep your mouth shut?

JANE. In my throat, mamma, it chokes me.

MAMMA. True; but where else?

EMILY. Oh, in my lungs; I begin to breathe with difficulty; then, I suppose, there must be some way by which there is a passage to the throat by the nose, as well as by the mouth?

MAMMA. Yes; the openings within the nose lead directly thither, and thence to the lungs, and to the stomach.

JANE. And I think it must be connected with the mouth too, for I can often taste a smell, at least I fancy so.

MAMMA. That is rather an odd expression; but I do not know how you could have described it otherwise; and you can easily prove the truth of your assertion, for if you hold your nose whilst you are eating or drinking anything, however nauseous,

you can scarcely perceive that its flavour is disagreeable. And a person who, from temporary or permanent disease, has lost the sense of smell, has hardly any taste.

JANE. The nose is made of bone, is it not, mamma?

FRANK. No; don't you remember, that mamma said, when she explained to us about the skeleton, that it was only formed of bone part of the way, and that the rest was cartilaginous, or else that we could not move the lower part of it backwards and forwards?

JANE. Yes, I remember it now.

MAMMA. The upper part of the nose is formed by a projecting portion of the skull, and the lower part, as you have rightly said, of a strong cartilage.

JANE. Does a person with a large nose smell better than one who has a small one?

MAMMA. Does the sense of smell depend, do you think, on the quantity of the fleshy or external part?

JANE. No, mamma; I suppose on the nerves.

MAMMA. Yes, and on the internal construction;

so I think you can answer your question yourself. The nostrils are canals, which lead into openings in the bone, which forms the base of the nose. These canals grow wider as they proceed inwards, and open backwards into the throat, and so communicate with the mouth.

FRANK. Do they lead any where else?

MAMMA. Yes; both upwards and sideways, into the bones in the front of the head, and into other bones which form part of the skull. Besides this, they extend into the cells of the bones of the face.

FRANK. How do you mean, mamma? Have the bones in our faces holes in them?

MAMMA. Yes; there are some called the Spongy bones, and there is also the Ethmoid bone; these you cannot feel, because they are placed behind the others; but they are so named, from the peculiarity of their formation. The word *Ethmoid* comes from two Greek words, signifying in the form of a sieve.

EMILY. What can be the reason that the bones are made so; I should have thought that they would have been so easily broken?

MAMMA. They would have been very liable to

injury, had they been in an exposed situation, but this is not the case; and though they are very light and thin, they are well protected, and are supposed to be instrumental in giving vibration and tone to the voice. This idea is confirmed by the difference between the voice of a person suffering from a violent cold in the head, and that of the same person when in health.

EMILY. Well, I should never have guessed what these bones were for, if you had not told us.

FRANK. Then, I dare say they are all covered over with something?

MAMMA. Yes; with a membrane called the mucous, the pituitary membrane, or the Membrana Schneideriana, which latter name it takes from the anatomist who discovered it.

EMILY. Where does this go?

MAMMA. It extends all over the winding passages I have described. There is another thing of which I have not yet told you; it is a little canal, which leads from the corner of the eye into the nostril, called the Nasal Duct, the object of which is to carry off the superfluous tears.

FRANK. Where do the nerves come from which convey the sense of smell to the brain?

MAMMA. They spring from that part of it which is situated in the front of the head, and are called, on that account, the first pair of nerves. They are called also the Olfactory Nerves.

EMILY. What course do they take?

MAMMA. I must first describe to you more particularly their construction, which is very curious. Their base is of a triangular shape, and towards the fore part it extends into a bulbous kind of form. This lies upon a crebiform or sievy plate of bone; then divides into numerous fibres, which pass through the holes in this sieve-like plate; and afterwards spread in a curious net-work form, on the mucous membrane, which covers that part of the nose which divides it, and forms the nostrils.

JANE. But, mamma, how do these nerves help us, as we do not put things up our noses in order to smell them, but we can perceive their odour at a great distance?

MAMMA. True, Jane; but the sense of smell is not excited by the bodies themselves, but by odori-

ferous particles which escape from them, and which are conveyed, through the medium of the air, to the nerves of our noses, and do actually come into contact with them.

JANE. Then should we smell nothing, if part of it did not come near us and touch us.

MAMMA. No, nothing.

JANE. But, after you have been smelling one of my pretty flowers, it does not look as if any of it was gone.

MAMMA. Yet, some particles of it must have reached my nose, or I should have perceived no sweetness in it.

FRANK. Can that be proved, mamma?

MAMMA. Yes, in a very simple manner. You know that lavender water and other scents, except they are kept tightly corked, soon disappear. This is particularly the case with æther, and all volatile spirits, and the finer the spirit, the more rapidly it is evaporated.

JANE. What do you mean by evaporated, mamma?

MAMMA. It means going out in the form of

vapour. I will give you a little bottle full of æther, and you shall try the experiment yourself. You will smell it very strongly in the air of your room, and in a few days you will find none in the bottle.

JANE. But, if I cork it very tightly, it cannot escape, I suppose?

MAMMA. Yes; and even if you put in a glass stopper, the only way to preserve it is to keep the neck of the bottle so closed, immersed in water.

JANE. Well, mamma, I should like to try; I will do all I can to keep it from flying away.

MAMMA. There is one very curious provision in the nose, of which I must not forget to speak, and that is, that when the pituitary membrane is inflamed, which would make it highly susceptible of pain and irritation from strong odours, the nature of the secretion in the nose is changed, which prevents the effluvia from bodies from reaching the nerve, in such a manner as to give it pain. This is the case when, from a cold in the head or other causes, we are nearly deprived, for the time, of the sense of smell.

JANE. Why do some animals smell better than

others? You know, mamma, you read us such curious accounts of the blood-hound, which could follow a person for miles and miles, through woods and across deserts, by only having smelt of the least thing that he had worn.

Mamma. The nose of such animals is formed internally, in a more intricate manner than that of the human species. The various windings are so involved, as to retain the effluvia arising from the odoriferous particles which have come into contact with them, for a longer time, and the perception of the scent is, therefore, both more distinct and more protracted. To us this faculty, though very important for comfort, is by no means so necessary as it is to animals, whose sustenance depends on their being able to discover their prey by this means.

Frank. Then it seems, mamma, that the scent of some animals is to them, what acuteness of hearing is to others?

Mamma. It is just so; and on others, again, God has bestowed the power of sight in a much greater degree than upon us, though I believe that there

is no animal which possesses *all* the senses together in such perfection as man.

I have told you how remarkably when we lose one sense, the others seem quickened and improved to supply its place; so that however we may lament the loss of any power, it is generally made up to us in some way or other.

EMILY. Has smell ever been of any particular benefit to any one, beyond its ordinary use?

MAMMA. Yes; there are curious facts related, to prove that even smell has thus almost supplied a defect of sight. One is the case of a lady, who became both blind, deaf, and dumb, and who was therefore only able to communicate with her friends by conversing with them on her fingers.

FRANK. But how could they answer her, as she could neither hear nor see?

MAMMA. They, in reply, pressed their fingers on hers, to give the answer in the same manner as I told you some persons could do with the deaf and dumb, in the dark.

EMILY. But how did her smell aid her?

MAMMA. She could perceive, when she entered a

room, by this means, when any strangers were present, and how many there were. She had a great dislike to be seen by those with whom she was not intimate, after she lost the senses of seeing and hearing, and the power of speech. One day, having been persuaded to go down stairs, with the assurance that none but her friends were in the room, the instant the door was opened, she found that some persons were there with whom she was not acquainted.

JANE. But how very wrong it was to try and deceive her.

MAMMA. It was not intentional, my dear; but they had come in whilst her friend was gone up stairs to fetch her, and she could not be pacified till she was repeatedly assured that this was the cause of the mistake.

JANE. I am almost inclined to think, that this is the most wonderful fact that you have told us yet, mamma; but I am not yet reconciled to losing any of my senses, though I do see that one can be much happier without them than I at first thought was possible.

FRANK. Suppose a person was to lose all, mamma, what would he do then; I suppose you will still say that he could be happy?

MAMMA. Yes; he would have the same unfailing source of happiness, if he knew that God was his God; his spirit could hold communion with Him, even if shut out from comfort as to outward things; and as a person may possess all earthly good, and be *unhappy,* so I believe he may be deprived of all, and yet be happy. He would not long be in this state of exclusion; he would be like a prisoner, waiting and longing for the hour of pardon and release; and then, think of the burst of joy, the abundance of bliss that would follow, to one who believed in Christ. He might well exclaim,—"This light affliction was but for a moment; but it has worked out for me a far more exceeding, even an eternal weight of glory."

Conversation XI.

On the Mouth and Taste.

Mamma. The next sense which we have to consider is that of Taste. You all know with what part of the frame this is connected.

Jane. Yes; with the mouth.

Mamma. And what do you include when you say the mouth? for it is not simply that opening through which food is admitted.

Jane. The lips, and the tongue, and all that hollow place which we see when we open our lips.

Mamma. And what is there in that hollow place?

Jane. The jaws and teeth.

Emily. And the interior of the cheeks.

FRANK. And the roof of the mouth.

MAMMA. And something else, otherwise the food which we eat would be but of little service to us.

EMILY. The throat.

MAMMA. Not the throat strictly speaking, but the opening into it, which contains many subdivisions, which I will explain to you when we come to talk of that in order.

FRANK. What a curious looking thing the tongue is, it is quite unlike any other part of the body. I cannot think what it is made of.

MAMMA. It consists principally of muscular fibres, intermixed with fat and cellular membrane. The muscles which compose it are distinguished by anatomists by different names, according to the functions which they perform, and the situations which they occupy.

FRANK. I suppose it is owing to the number of muscles which the tongue contains, that we can move it about so easily, and bend it either up or down, or curl it round.

MAMMA. It is so; and it can, for the same reason,

either be contracted into a very small compass, or elongated or lengthened at pleasure. The power of doing so is of great consequence to those animals who take their food by lapping it up with their tongues, which is the case particularly with the young of many species. Of how many parts does the tongue appear to you to consist?

EMILY. Of an upper and under surface, of edges, and a root.

MAMMA. Yes; the upper part of it is called the Dorsum.

FRANK. I wonder at that, because dorsum means the back. I should have thought that the under part would have had that name more properly.

MAMMA. But it is not unusual to apply that term to the upper, and most projecting part of anything.

EMILY. Oh, yes; we call the upper part of all quadrupeds their back; and I suppose it is on the same principle that the upper part of the tongue is so named?

MAMMA. What do you observe, down the middle of it? (Plate IV. *a*.)


b
d
e
a
b
d
c
e

EMILY. A kind of mark or line, which looks like a crease to fold it by.

MAMMA. Yes; and on each side of that line are blood-vessels and nerves, which exactly correspond with each other. The tongue is covered all over with little raised fleshy substances called Papillæ, which vary in size in different parts of it. They are the largest at its root, and those are therefore distinguished by the name Papillæ Maximæ. They are like small glands, with hollow spaces round them, called Fassulæ; so that their heads only are seen. The word fassulæ comes from a Latin word signifying a ditch.

FRANK. Oh, mamma, then I will tell you what I think they must be exactly like, only on a very small scale, and that is the Martello towers, which you remember we used to see so many of on the coast of Kent. They did not look half so tall as they were, till you went up to them, and then you saw that half the tower was below the surface of the ground, with a wide ditch surrounding it.

MAMMA. Yes, Frank, I think your illustration will do very well, only we must, indeed, reduce the

Martello tower most wonderfully in size, to make it resemble the papillæ on the surface of the tongue. The head only is visible, but they are joined by short stems to the bottom of the fassulæ. Another thing also is found near the root of the tongue; this is called the Foramen Cœcum. What do you think that means?

Emily. Is not foramen, an opening; and cœcum, concealed or hidden?

Mamma. Yes; but the word cœcum in anatomy, is generally used to express a blind hole, or that which is shut up at one end. The foramen cœcum is of the same kind with the papillæ I have before described, only larger; and in it are found small salivary ducts, that is to say, channels, through which saliva passes.

Jane. What is the saliva?

Mamma. I have told you before that there are various processes constantly going on in the body, for the purpose of forming matter of different kinds, to answer particular ends. That secretion which is peculiar to the mouth is saliva, the sources of which are very numerous, as it is made by the various

glands connected with the mouth and cheeks, and tongue. It is also mixed with mucous fluid, which is produced from the general surface of the mouth, but is not peculiar to that organ, being also formed in various parts of the body. It is at the root of the tongue that the secreting mucous surface begins to resemble the glandular structure of the Œsophagus.

FRANK. What does that mean, mamma?

MAMMA. This is the name given to the passage from the throat to the stomach.

FRANK. Of what use is the saliva, mamma?

MAMMA. To moisten the surface of the mouth,—to assist in chewing the food, and in preparing it to be swallowed. It also assists in digestion, and unless the process of its formation moves on rapidly and easily, we should suffer intense pain during the time we were eating, as well as afterwards. It is probable, also, that it contributes to the sense of taste.

FRANK. You said that there were different kinds of papillæ, in different parts of the tongue, did you not?

MAMMA. Yes; they are divided into four kinds; the first I have already described to you, they are called also Truncatæ, or stump-shaped. The second class are smaller in size, and are called Fungiformes, that means shaped like a mushroom; and also obtuse papillæ, both of which names describe the same kind of shape. These are placed forwarder on the tongue than the first kind. The third class are mixed in with the second, and are called Villosi or Conicæ. Villosi means soft or velvet-like; and conicæ, in the shape of a cone.

EMILY. And what is the fourth class, mamma?

MAMMA. It is the most important of all. These papillæ are seen on the edges and point of the tongue, and are of a bright red colour. It is in these that the sensation of taste peculiarly resides.

FRANK. Then is the tongue covered with skin like the rest of the body?

MAMMA. Yes; with the different skins I named before. The under part of the tongue is like the general lining membrane of the mouth, being a secreting surface.

JANE. When we lift up the tongue, there seems to be something that holds it down, what is that mamma?

MAMMA. It is a strong ligament called the Frenulum Linguæ.

FRANK. Does not that mean the bridle of the tongue?

MAMMA. Yes; and that word just explains its office, which is to prevent the tongue from turning too far backwards into the throat; which, if it did, would occasion suffocation.

JANE. You said that people could stretch out their tongues, or make them smaller, or swell them up if they liked; now, mamma, it is that power, I suppose, which enables the ant-eater to get his food so curiously?

MAMMA. It is my dear. How did I tell you he managed to catch ants?

JANE. By spreading his long red tongue over an ant-hill, and lying quite still by the side of it; then the insects supposing that it was something very good to eat, ran upon it, and as soon as he found

that they had done so in great numbers, he drew it in, and swallowed them all up.

EMILY. But how is it that they do not sting him afterwards? It must be most dreadful pain to be stung where you could do nothing to alleviate it.

MAMMA. The heat of the stomach is so great, that it will deprive almost any animal of life, as soon as it reaches it.

JANE. I am sure that is a very good thing, for since we have been to see that wonderful microscope, I have often thought as I was drinking, what frightful creatures there were in the water.

FRANK. But those creatures which we saw like scorpions were found in river water and in pools; but spring water is much purer.

JANE. I am glad it is, for there is something very disagreeable in the idea of swallowing so many creatures alive in every drop we drink.

MAMMA. Do you remember the story I told you about the Brahmin?

EMILY. Yes; you said that that caste of the Hindoos think it sinful to take away life; and that when an Englishman showed one of them, through a

most beautiful microscope, that every drop of water was inhabited, he became perfectly miserable.

JANE. Yes; and the Brahmin would not let him rest, till he had made him a present of the microscope, which as soon as he had got he dashed it into a thousand pieces.

MAMMA. Now let us return to our subject.

FRANK. May I ask you, what part of the mouth is called the palate?

MAMMA. The roof of it, which is composed of thin bones, covered by the Periosteum, or ordinary covering of bones, and the common membrane of the mouth, which towards the teeth form numerous wrinkles or folds, to assist in the division of the food. This is called the hard palate. Quite at the back of it you will see suspended a fleshy membrane, which gives great security to the throat.

EMILY. Has that membrane any particular name?

MAMMA. Yes; it is called the Velum Pendulum Palati. What does that mean?

EMILY. Is it not the hanging veil of the palate?

MAMMA. Yes; and it is called also the soft palate. This velum palati is rounded into two arches, (Plate

IV. *b, b.*) and between these hangs the Uvula, (Plate IV. *c.*) which takes its name from — what do you think?

FRANK. I suppose that it is thought to be like a grape from its name; am I right?

MAMMA. Yes, my dear; it is a large, soft papilla, having in it muscular fibres, by which it is moved about. It seems to be placed where it is as a sort of protection, and to prevent food from going too rapidly into the throat.

FRANK. It resembles then in some degree the valves, which are placed in the auricles, for the purpose of preventing the return of the blood to the heart.

MAMMA. Yes; except that it does not close up the passages as they do, but only presents a temporary impediment. The edge of the velum palati is rounded on each side so as to form what are called the Fauces, or arches of the palate, (Plate IV. fig. *b, b.*)

EMILY. Are they of a similar construction to the velum?

MAMMA. Yes; they are muscular fibres covered

with the same soft membrane. There is a double arch on each side of the uvula, and these are separated from one another. You can easily distinguish it in the picture; and there is some distance between the arches in front, which are called the anterior, and those behind, which are named the posterior, (Plate IV. *d, d.*); the uvula hangs from the centre of the four.

FRANK. Then, mamma, I think *that* part of the throat must be something like the entrance of an ancient castle, and the division between the arches is the place in which the portcullis used to be.

MAMMA. Yes; that will give you a very fair idea of the form of the throat; only you must remember the wide difference between the soft yielding texture of the membrane, and the thick massy walls of the castle. Behind the soft palate, is the opening upwards into the nose, and in swallowing, the uvula is drawn up and closes this channel, and the arches of the throat contract, so as to draw it into a funnel-like shape, which forces the food down the throat.

EMILY. Have you now told us, mamma, all that there is in that part of the mouth?

MAMMA. No; there is placed between the two sets of arches which I have described, a mucous gland on each side, full of large cells, and loosely covered with a membrane.

JANE. What are the cells for, mamma?

MAMMA. These glands supply much moisture to the throat, and the cells are the mouths of the ducts, through which it comes out.

EMILY. Have these glands any particular names?

MAMMA. Yes; they are called the tonsils, or Amygdalæ, (Plate IV. *e*, *e*.)

FRANK. Have they that name because they are supposed to resemble almonds?

MAMMA. Yes, in form, though not in colour. The cells in the tonsils are irregular, in order that they may retain the mucus until it is forced out by the pressure of food against them.

FRANK. I suppose, mamma, as you said that all sensation depended on the nerves, that the mouth and tongue are supplied with them?

MAMMA. Yes; there are branches of nerves which are dispersed amongst the muscles of the tongue,

and lower jaw, and the glands under the jaw, terminating in numerous threads, which form a net work amongst the muscles of the tongue, and branches from another pair of nerves, called the fifth pair, supply it also.

EMILY. Then how are they situated, so as to come in immediate contact with our food?

MAMMA. In the papillæ, which I have described to you on the surface of the tongue, are seated the extremities of the gustatory nerve, as that is called from which we derive the sense of taste. These papillæ are full of vessels, and are seated in the true skin of it.

EMILY. Mamma, did you not say that it was only those on the edges and point of the tongue, which gave the sensation of taste?

MAMMA. Yes, I did, and it is easy to observe the wisdom of this arrangement, because the central part is used in connexion with the roof of the mouth in breaking up the rough particles of food; and as these papillæ are extremely sensitive, we should have felt pain whenever we ate had they been universally

distributed over its surface. The sense of taste is, however, incomplete until the food has passed into the throat.

EMILY. What an intricate process everything has to go through, which seems to us quite simple till we know more about it.

MAMMA. Yes; and yet all this machinery is so contrived that none of it is in danger of interrupting the work of the other parts, and none could be dispensed with without injury to our comfort.

Conversation XII.

ON THE FINGERS AND TOUCH.

Mamma. I think I have now given you an account of nearly all the senses. Tell me, Jane, which remain to be explained?

Jane. We know how we see, and hear, and taste, and smell; then there is only one left, and that is feeling; will you tell us about it now, mamma?

Mamma. I will, my dear; where does the sense principally reside, which you call feeling, but which is more properly denominated touch?

Emily. In the fingers.

Mamma. Yes.

Jane. But I feel in every part of my body, if any thing touches me.

Mamma. True; but the fingers are the instru-

ments formed for the express purpose of distinguishing between the properties of bodies; or rather I should say that this is *one* great object for which they were made, and they are supplied with nerves and vessels adapted to this end. What qualities can you discover by touch?

EMILY. Whether a thing is hard, or soft, or hot, or cold.

JANE. Or round, or square, or oblong, or sharp, or flat.

FRANK. Or thick, or thin, or smooth, or rough.

JANE. I think that touch does, whatever the other senses cannot do, all but see, and hear, and smell, and taste.

MAMMA. And yet there are some instances which show that the touch can discover things, which you would think belonged only to the province of the eyes.

JANE. To the eyes, mamma, what could they be?

MAMMA. It appears to be well authenticated, that some blind persons, have, by means of touch, been able to discover the difference of colours.

FRANK. I do not see how that can be true, be-

cause colour cannot alter the feeling of the surface of anything.

MAMMA. It is not easy to prove that, one way or the other, but it is an undoubted fact, that when one power or sense is lost, the others are made in a remarkable degree to supply the deficiency, by obtaining an increased delicacy of perception. The account I have given you of what blind persons are able to do by means of their fingers, will convince you of the truth of this assertion.

EMILY. Yes; Euler and Saunderson were proofs of it indeed.

MAMMA. The sense of touch has been thus defined.—"It is the change, arising in the mind, from external objects applied to the skin, and more especially to the ends of the fingers."

EMILY. The nerves, I suppose, have a good deal to do with the sensation which touch produces?

MAMMA. Just so, but before I come to that part of the subject, I must tell you about the skin.

JANE. I remember you told us before, that we had three skins.

MAMMA. Yes, you are right; some anatomists

say that there are more, but this is to make an unnecessary subdivision. The first is called the cuticle, epidermis, or scarf-skin; the second, the rete mucosum, or reticular tissue; the third, the cutis-vera dermis, or true skin.

FRANK. When you say the first, do you mean the innermost, or outermost skin, mamma?

MAMMA. That on the outside, or the most superficial.

EMILY. I do not quite understand the meaning of the word superficial.

MAMMA. It is derived immediately from the French — *superficiel*, which means precisely the same as the English word; but it comes properly from two latin words *super*, above, and *facies*, the face; therefore superficial means, that which is on the face, or the surface of anything. When a person has only a slight acquaintance with a subject, we say his knowledge is superficial, that is, that it is not deep or profound. Thus the first or outside skin is said to be superficial. In young persons it is transparent.

JANE. How can that be mamma; because if it was

transparent we should see all that was going on underneath it, and we do not see that?

MAMMA. You are mistaken, dear. You see colour, in the face for instance, which, as you will find presently, is seated in the second skin; and unless the first skin was transparent nothing would be seen beneath it.

JANE. I beg your pardon, mamma, I thought you meant that all the skins were transparent.

MAMMA. The cuticle is also insensible, as you know that pieces of it often peel off without occasioning you any pain. It also resists the external impression made by bodies, and blunts the too acute sensation of the cutis-vera.

EMILY. Is it equally thick in all parts of our bodies?

MAMMA. No, it is not; on the palms of the hands and the soles of the feet, where it has to resist strong pressure, it is thick, but it is very thin over the rest of our frame.

FRANK. Does it get harder and thicker sometimes, mamma, by use, for I have noticed that workmen,

such as smiths and carpenters, have their hands like a piece of board?

MAMMA. Yes it does, my dear. When I was explaining to you, how it was that the blood decreased in quantity, and continually required a fresh supply, I told you that much of it was absorbed, that is carried off through vessels called absorbents, in the form of perspiration, and in other ways.

EMILY. Yes, mamma.

MAMMA. The extremities of these vessels, and the ducts of the glands of the skin, perforate the cuticle. The nails are connected with the cuticle, and their purpose is to make the ends of the fingers stronger, so that they can resist pressure.

FRANK. You said that the cuticle had no sensation, and I think that the nails cannot have either, or it would hurt us when we cut them.

MAMMA. No; they have not any, neither are they supplied with vessels.

EMILY. What makes them grow then?

MAMMA. The nourishment which they derive from the body.

JANE. But if they have no vessels, how can they

go on growing from their ends?—How do they get their support?

MAMMA. You are mistaken, my dear, as to the manner of their growth, which is like that of a tree from the root, through the nourishment which they receive there. The hairs grow in a similar manner.

EMILY. How can it be proved that they grow from the root, as we see them increase in length at the other end?

MAMMA. You may easily satisfy yourself on that point, by making some mark on your nail, near the base of it, and you will soon find that it gets nearer towards the top of it, till at last you will cut it off.

FRANK. Oh, yes, I have observed that, but I did not know why it was so.

MAMMA. Did you ever look at your hands, or at one of your fingers through a magnifying glass?

EMILY. I have, mamma.

MAMMA. And how did they look?

EMILY. As if they had large pin holes all over them, where I thought before they were quite smooth.

MAMMA. And did you observe anything projecting from those holes?

EMILY. Yes, short hairs.

MAMMA. These answer in some degree the same end as the absorbents.

JANE. I should have thought that they stopped up the small holes in the skin like corks, instead of helping to carry anything off from it?

MAMMA. It would be so if each of those little hairs, was not a hollow tube.

JANE. Oh, mamma, how curious! how can that be found out?

MAMMA. By means of the same instrument I just now mentioned, a magnifying glass; with a powerful one, you can distinctly see the bore, or hole in the hair.

JANE. How I should like to see it myself!

MAMMA. If you want another proof of it, I can easily give you one. In Poland there is a very dreadful disease, to which the inhabitants of that country are subject, which is, that these little tubes absorb blood from the head, and are filled with it, so as to resemble unprotected veins growing on the outside of the body; and if the hair was cut the patient would bleed to death.

JANE. How dreadful! I hope that complaint is never known in England?

MAMMA. No, I have never heard of an instance of it.

FRANK. What is the name of that shocking disease?

MAMMA. The Plica Polonica; it is caused by several blood vessels running from the head, into the ends of the hairs, which become matted together by a humour which flows from them.

EMILY. Where do the hairs grow from?

MAMMA. From a bulbous root seated in the Cellular Membrane.

JANE. Do you mean a root like my hyacinth?

MAMMA. Yes; only much smaller in size. The bulb of the hair is vascular, and is connected by vessels with the Cellular Tissue. It consists of a double membrane; the outer one is like the external skin of a bulbous root, and does not extend beyond the pore, through which the hair passes.

EMILY. You said that the root of the hair was seated in the cellular membrane; what is that mamma?

MAMMA. It takes its name from its appearance, being everywhere covered with little holes or cells.

FRANK. Whereabouts is it?

MAMMA. All over the body; it unites the muscles, and surrounds every vessel and nerve, and when compacted firmly together, it forms the membranes.

EMILY. I used to wonder when I read that text, "Even the very hairs of your head are all numbered," what it could mean, but I understand it better now, for there seems to have been as much pains and care bestowed upon the formation of those insignificant things connected with our frame, as upon everything else belonging to us.

MAMMA. And the more closely we look into these minute and apparently unimportant details, the more elevated will our views become of the love and care, and watchful tenderness of that gracious Father, who thinks nothing beneath his notice which concerns his children.

EMILY. I like to think of that, because it helps me to believe that God can care even for me, though I am but a child.

MAMMA. Tell me the name of the second skin, which lies under the cuticle?

FRANK. The rete mucosum. I suppose that means a net, does it not?

MAMMA. Yes; and it is so named from its resemblance to one in structure.

EMILY. And what does mucous mean?

MAMMA. It comes from the Latin word *mucosum* which signifies slimy, which describes the nature of this membrane. It is the seat of colour.

JANE. Then, is it black in the negroes, and white in white people, and copper-coloured in the Indians?

MAMMA. Yes; and this colour is discoverable through the transparent cuticle, which, in persons of dark complexions, is often remarkably soft and delicate.

EMILY. Is the second skin of any other particular use?

MAMMA. Yes; for defending the delicate papillæ of the true skin, which lies underneath?

FRANK. I remember you gave us three names for it, the cutis vera, the dermis, and the true skin.

MAMMA. You are right, my dear; the third name, you see, is only an English translation of the first, which is Latin.

FRANK. Yes, mamma.

MAMMA. This is a dense, elastic, and vascular membrane, which lies under these outward laminæ.

JANE. What does that word mean, mamma?

MAMMA. The coats, or layers, which are placed one above another. The outer surface of the cutis vera is dense, but the internal layers are loose, and gradually degenerate into the cellular substance.

EMILY. Does the thickness of this skin differ, according to its situation, as well as the outer one?

MAMMA. Yes; it is thin and transparent on the lips and eyelids, and in some other places.

FRANK. But, mamma, does sensation reside in the skin?

MAMMA. No; it is only the medium through which the impressions of outward objects are made upon those nerves, which from their connection with the skin, are called cutaneous. These, like all the other nerves, have their origin in the brain, which sends down large branches into the arms. These are sub-

divided into smaller and smaller twigs, and these send out very fine and tender shoots all over the wrists, hands, fingers, and thumbs.

FRANK. And how are they protected from injury?

MAMMA. By the bones and muscles of the arms. They pass through the latter in their course downwards; some of them also run parallel with the arteries and veins of the arm.

EMILY. It must be very difficult to describe all the nerves connected with the sense of feeling, because we feel in every part of our bodies, and there must be such an immense number of them to produce this effect.

MAMMA. Yes, it is so indeed; but the fingers and hands are more peculiarly supplied with nerves, because in them, properly, is the seat of touch.

FRANK. What proof have we that the nerves are so immediately connected with the brain?

MAMMA. It is easily shown in the dissection of bodies, but it can be proved also during life; for if anything happens so as to produce an injury in

the spinal column, from whence some of the nerves proceed, all sensation ceases below that part.

EMILY. I thought that all the nerves came direct from the brain?

MAMMA. They do; for the spinal marrow, which is contained in the spine, is a continuation of the same substance.

JANE. But we do not think in our backs, do we, mamma?

MAMMA. I believe not; but you will soon perplex yourself, my dear, if you try to find out where and how we think, and what thinking is. We must be contented to know, that we have not only a mind, but an immortal soul, which is like him who formed it, a never-dying spirit.

JANE. How many things there are which we can never know!

MAMMA. A great many of these things, our Lord tells us, we "shall know hereafter;" for in that blessed world to which his people will be admitted, all our powers and faculties will be as much superior to those we have now, as the heavens are high above the earth. But I have a few more things to say to

you on the subject we have been talking about, before we leave it.

EMILY. May I first ask you, mamma, whether touch and feeling mean exactly the same thing? I think you said that they did not; and if so, what is the difference between them?

MAMMA. No, they do not; that was one point I was going to mention. Touch is more properly the external act by which we bring anything into contact with our fingers; whilst feeling is the internal sensation communicated to the nerves by the touch.

EMILY. Do the nerves go exactly in the same direction in every person?

MAMMA. No, they do not.

FRANK. I think I have heard persons use the word nervous in two different senses.

MAMMA. Yes; and the two must not be confounded together. A person is said to be nervous who is weak and quickly susceptible of pain. In this sense it means, that his nerves are easily excited, and in an unhealthy state.

FRANK. And in the other sense it means just the opposite, does it not?

MAMMA. Yes; it means that he is full of vigour. It is not unusual to employ the word in this acceptation figuratively, in describing writing or composition. A man is called a nervous writer, who expresses his ideas with clearness and force. Can you think of any more questions which you wish to ask me before we leave off; for I have now finished the account which I promised to give you of the five senses.

FRANK. No, mamma, thank you, only I am sorry you have done.

MAMMA. If we think how limited our enjoyments would have been, to what they now are, had we been left without these powers, or with only a few of them, is it not strange that our hearts are so seldom filled with gratitude and praise for these great mercies. We take them too much as common things, as though they belonged to us of right, instead of being all the free gifts of God's love. It has been well observed, that we might have had these senses bestowed upon us, and yet each of them might have been only avenues of pain, instead of sources of delight. Let us, my dear children, continually think

upon our blessings, remembering that we are only stewards, and that we must give an account of the use we make of every talent. My earnest prayer for you all is, that every faculty of your bodies, and every power of your minds, may be consecrated wholly to Him, "whose you are;" and who, "for the great love wherewith he loved us," "spared not his own Son, but delivered him up for us all," "that whosoever believeth in Him should not perish, but have everlasting life."

FINIS.

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ERRATA.

Page 46, line 7 from bottom, *for* pluera *read* pleura.
159, line 9 from top, omit *it*.

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